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SEPTEMBER
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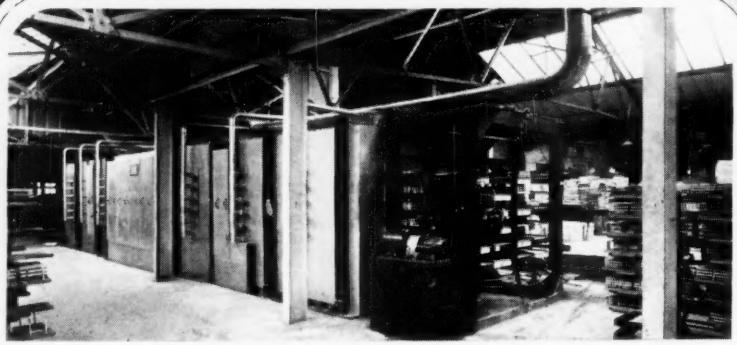

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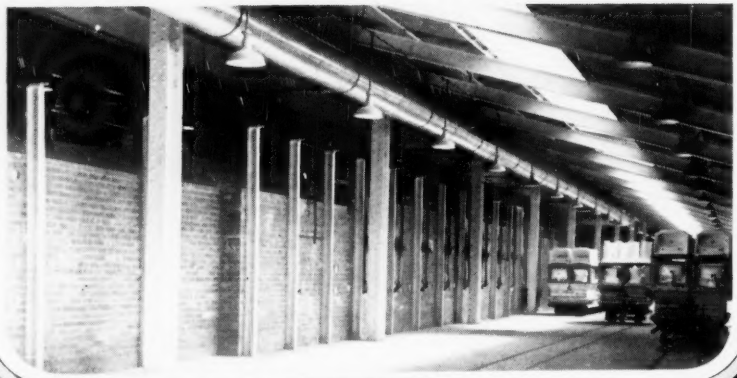

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CERAMICS

SEPTEMBER, 1951

EDITOR

W. F. COXON, M.Sc., Ph.D., F.R.I.C., F.I.M.

A monthly journal covering the whole ceramic field including pottery, glass, heavy clay, refractory and silicate industries.

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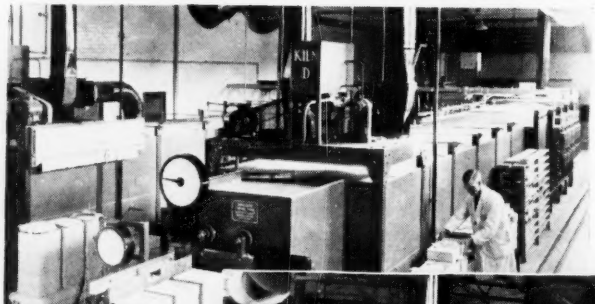

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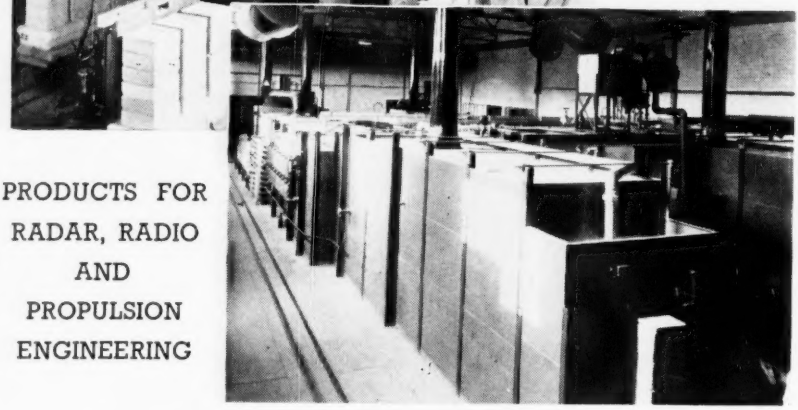

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Ceramics

VOL. III SEPTEMBER, 1951 NO. 31

THE T.U.C. AND PRODUCTIVITY

RECENTLY the brassfounders paid a visit to America under the auspices of the Anglo-American Council on Productivity and their full report is available from the Council at 21 Tothill Street, London, S.W.1, at 7/6 post free.

Among the permanent representatives of this Council are, Mr. Lincoln Evans, C.B.E., general secretary, Iron and Steel Trades Confederation; Mr. Arthur Deakin, C.H., C.B.E., general secretary, Transport and General Workers' Union; Sir William Lawther, J.P., vice-president, Trades Union Congress, president, National Union of Mineworkers; Mr. Andrew Naesmith, C.B.E., J.P., director of the Bank of England, secretary, Amalgamated Weavers' Association; Mr. Jack Tanner, president, Amalgamated Engineering Union; Mr. Tom Williamson, J.P., general secretary, National Union of General and Municipal Workers.

The particular report in question was presented unanimously and includes the following among its conclusions and recommendations:

It is evident that the output per man-hour is greater than in British plants of similar type and size. It is our unanimous opinion that this is due to the following reasons:

1. A greater incentive to earn, due to the American way of life; and the will to work hard and effectively;
2. A closer relationship between management and employees;
3. The widespread use of a layout of simple but efficient design by even the smaller type of jobbing foundries;
4. The maximum use of mechanical aids to conserve effort, associated with a close study of users' needs by plant manufacturers and designers;
5. The effective use of standardisation, simplification and specialisation methods;

6. The use of patterns and core-boxes of high quality and accuracy;
7. The willingness to try out new methods and techniques and to expend capital on plant;
8. The attention given to planning, welfare, safety and housekeeping measures.

It has been said that in Britain today we value security and leisure more than a better standard of living. The average American, on the other hand, prefers to produce more to earn enough money to buy a house, a new car, a television set, an electric washer or anything else that he may fancy.

All the shops are full of goods that the worker wants and taxation is not so high. Furthermore, direct taxation remains at a fixed percentage up to high salary levels. The natural inclination of the American worker, therefore, is to earn as much as he can, and in this direction he is assisted by his Government, employer, and trade union. The provision of greater incentives to earn is therefore a primary requirement for promoting increased productivity in the brassfoundry industry in the United Kingdom, although these may not necessarily follow the American pattern.

When a real incentive to earn has been created the maximum use of mechanised aids incorporated in a layout of simple but efficient design by even the smallest type of jobbing foundry, will follow naturally. For both management and worker will then want mechanisation to increase output so that they can produce and earn more. Without suitable incentives there is a danger that the greater use of mechanical aids may lead, not to increased productivity, but to more leisure and shorter working hours.

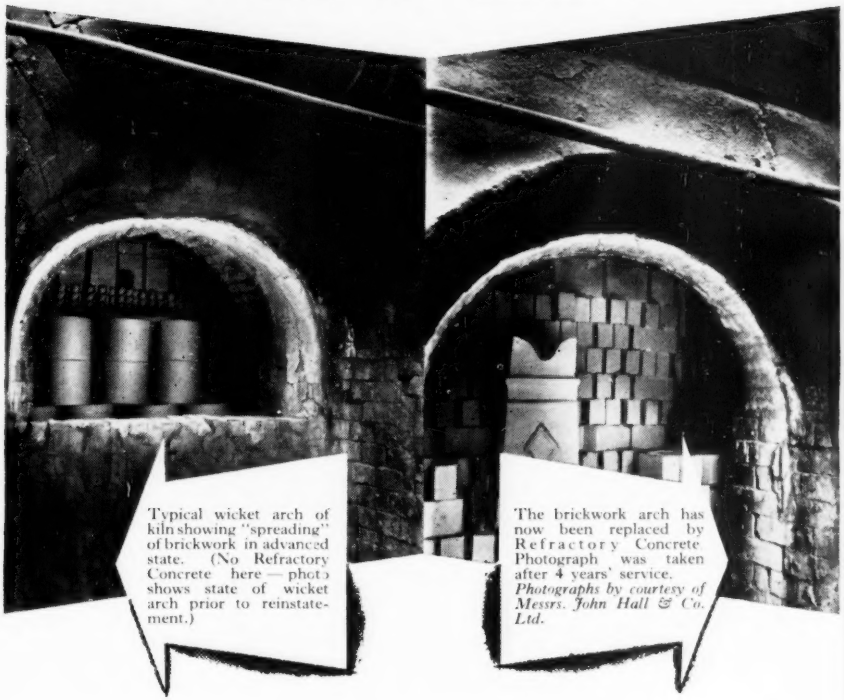
In order to obtain increased productivity in the United Kingdom it is suggested that the following recommendations should receive careful consideration:

1. The Government should endeavour to inspire anew the spirit of adventure in both management and worker.
2. Industry should promote a greater incentive to earn amongst all levels of employees by the introduction of bonus and incentive schemes.
3. Greater attention should be given by management to plant layout, production planning, maximum use of mechananical aids, standardisation and simplification methods and similar factors likely to increase production. Equipment manufacturers should study the needs of the foundry industry and develop equipment to suit its specific requirements.
4. Employers and worker organisations should endeavour to create close and harmonious relations; the American plan of union contracts between individual companies and their workpeople suggests an approach to this problem. In any case politics should have no part in industry.
5. Management, foreman, and worker should forget old-fashioned traditional ideas which often hinder production, and endeavour to emulate the American approach to new ideas, processes and techniques. What was good enough for Grandad may not be the best today.
6. The British worker should make up his mind whether he wants security and leisure or a better standard of living. The latter can be obtained only by effective work, industriously applied, so typical of his American brother.

Will Messrs. Evans, Deaking, Lawther, Naesmith, Tanner and Williamson, present the report under their auspices to the T.U.C., with the object of implementing the above conclusions and recommendations?

Or since 25th October is "Der Tag" maybe they have left it too late.

Wicket Arch constructed in REFRACTORY CONCRETE



Typical wicket arch of kiln showing "spreading" of brickwork in advanced state. (No Refractory Concrete here — photo shows state of wicket arch prior to reinstatement.)

The brickwork arch has now been replaced by Refractory Concrete. Photograph was taken after 4 years' service. *Photographs by courtesy of Messrs. John Hall & Co. Ltd.*

The above right-hand photograph shows one of several Refractory Concrete wicket arches constructed with Ciment Fondu and crushed firebrick in use at one works.

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COMMENT

by ARGUS

NAIVETY and disingenuousness called by the uncharitable, misrepresentation, is a curse of our existence. For example comes the following editorial quotation from the *Daily Herald* of 18th September, 1951. "The problem of the cost of living is a tough one. The major cause of that difficulty lies outside the control of the government of any one country. The cause is stockpiling for defence needs and the most powerful remedy would be international control over distribution of vital raw materials such as our own government has urged." This sounds good!

It is excellent platform politics and rather makes nuts of Mr. Dalton's suggestion that the cost of living is due to the greedy capitalists and entrepreneurs who are holding on to the goods for high prices!

Look at the Facts

But let us in our own interests look through the woolly maze of political propaganda at the facts, such as they are. What raw materials are possessed by the United Kingdom? Obviously coal which we cannot get and have to import! Apart from that we depend upon imports for iron ore, for non-ferrous metals for two-thirds of our food, for wool, for cotton and indeed for practically every raw material used to produce those finished goods upon which British manufacturing prestige has been built. The simile can be vividly portrayed in the portals of the local pub in which one man sits with an empty glass and the others with glasses partially filled. He conducts a most forthright campaign for the pooling of the whole beer purchasing resources by the gathering so that all should have an equal share. So what!

Deliberately Misleading

Frankly, in a world where nationalism and national survival on the Darwinian basis is probably higher than it has ever been in the history of industrialism, is there any sane economist or politician or ordinary man-in-the-street who imagines that by getting the nations round the table that Canada is prepared to allocate its nickel, Australia its iron and steel, Persia its oil or America its copper on this basis? This sort of comment is deliberately misleading for it presupposes that the Government has a plan but it does not indicate that the plan is based upon the fallacy that humans and nations are prepared to play the good Samaritan.

Of course they pass by on the other side of the street until they see the burglar round the corner, then they nip smartly over and do a deal in their own interests and protection. This is international politics, many examples of which have been seen in the League of Nations and U.N.O.

When the nations have got together to bargain it is always a question of driving the hardest bargain. When you have an empty industrial raw material stomach, such as we have in the United Kingdom, it is the height of futility to try and put over that bluff!

The Result

But going back again to Mr. Dalton's tirade about ceasing from buying until prices fall, this is indeed a wonderful prospect. In the end it means one of two things; either the goods remain unsold, in which case

the factories producing them stop producing and the workers therein find other employment or, alternatively the goods are sold below cost, in which case the retail trade goes broke and its employees look for other jobs.

In competitive trading on a private basis the customer has the surest protection by getting goods at the most reasonable price. It is only in the industries where Mr. Dalton's friends have taken supreme command that the customer has no redress for there is no competition but merely a nationalised octopus-like monopoly. In fact, Mr. Dalton would like consumer resistance in the case of coal, gas and electricity; it would be no hardship to the national boards concerned, they would not go broke and the job of the politicians would be made easy by the chilliness of their customers in the winter months.

The fact that the National Health bill would go up through coughs and colds and output in productivity would go down from similar causes are two moves on the chess board and our planners lack the comprehension of even realising the implications of the one move, they are making.

Mr. Dalton please listen to Mr. R. A. Maddock a member of the British Pottery Manufacturers' Federation and the local Gas Consultative Council. "The price of gas at the moment is frightening. It is already cheaper at the moment to fire by oil (imported) . . . What ho Mr. Dalton! Gas is your Government's baby!

Different Voices

Yet these people speak with different voices on the same day in different places. On the one hand Mr. Dalton accuses the greedy capitalists of causing high prices and yet Mr. Hugh Gaitskell, talking to the T.U.C. at Blackpool early in September said that neither increases in direct taxation nor the transfer of money from companies profits to wages was a solution to Britain's problem.

He said ". . . if you take away all the excess net income above £2,000 a year it would bring in only £53 million." He said further, that ". . . we really cannot say that high profits have been an important cause of the rise in the cost of living." So Minister Dalton a former Chancellor, says to Minister Gaitskell the present Chancellor and vice versa (both of them under the protective umbrella of Transport House), that they are respectively crass idiots.

Yet with this disagreement on fundamentals they shout in unison on another occasion like the well-know figure in Hyde Park, "I've got a plan!"

Japan at Peace

When it comes to real issues, areas like the potteries face the blast of the politician's criminal negligence in economics more viciously than other parts of the community. There the population is closely knit and congested. There the livelihood of the people depends upon the wheels of industry turning continuously.

The development towards mechanisation has meant that the factory is efficient only at optimum production and therefore goods must be disposed of to maintain that optimum. For the past few years the world market has been there, with Germany and Japan screened from commercial activity, but have no doubt about the effect of these two countries following the recent peace negotiations. America is wooing Japan and one thing the ardent swain can offer more than anything else is freedom to prosecute their very doubtful commercial practices upon the rest of the world.

Conditioned as they are in Japan to low wage rates, this cannot but help to hit directly at those countries with higher standards of living. The advent of Japan, which just before

the war had cornered nearly half the world's export market in pottery, is to be viewed with alarm by the potteries. It is all right to say that the little yellow leopards have changed their spots, but wait and see!

Even before this peace treaty there were complaints to the former President of the Board of Trade about Japanese copying of Britain's china and the ex-Mikado, General MacArthur, merely laughed at our complaint. In short the overseas market for pottery is going to be curtailed a lot in the next two years.

Standard of Living

At home there is an obvious consumer resistance to all domestic goods, and there were those who preached the gospel that it was good to export pottery as long as you could for there was always that vacuum market to act as a buffer against reduced exports. But is this so? The rising cost of living and the depression of real wages and salaries has more or less killed that market.

It is no good either party coming along playfully suggesting that we should put a cross in this or that place on the ballot paper to solve our problem overnight. We have got to face drastic economies and with the rising standard of living of the millions in India and Asia, an adverse affect upon our standard of living in a world where there are limited food resources is bound to occur. The only sensible thing to do is to face this problem. The British people are probably the best in the world at doing that, as witnessed after Dunkirk when any other nation in the world would have handed in its checks!

Wishful Thinking

This continual shouting, one month that we have rounded the corner, and the next month that someone has moved the corner back, produces a lack of fighting spirit for survival.

We can face up to realities now, dig in our toes, pull in our belts, abandon luxuries and live in austerity providing that the managers of the country have some experience of management. Unfortunately in terms of solid business experience, it is doubtful whether ten people in the Government could run a successful fish and chip shop in Hanley, unless they had an inexhaustible fund to pay the bills for the mistakes they would make. But is it sane and sensible to expect the politicians on either side to solve this real problem? Or to imagine that international control in a million different languages is real and practicable, when the Russians, Americans, Japanese and the British do not even accept the same basic axioms of the term civilisation? All this is wishful thinking in the extreme and amounts to an un-Christian exploitation of the mass of the people whom, through no fault of their own, are incapable of clear thought.

The latter may be excused but those whom can think and whom do see these problems but are prepared to pass them over in favour of selfish and immediate interests are sinners whose sins can never be expunged.

MASTERY OF MEASUREMENT

UNDER the above title Marconi Instruments Ltd., St. Albans, Herts, have isued a comprehensive booklet describing the types of instrument which they manufacture. They include voltage, power and frequency measurement, bridges and Q meters, power and frequency measurement, oscillators, signal generators, transmission measurement, as well as instruments for television and radar. Among their industrial instruments are a moisture meter and a direct reading *p*H meter. Also the booklet describes their electro-medical apparatus. Illustrations and useful line diagrams show the wiring of the instruments, and at the same time suggested uses for the different types of apparatus are outlined.

Well worthwhile to have on the shelf particularly in view of the growing importance of instrumentation and accurate measurement in most industrial processes.

The Effect of Furnace Atmospheres on Ceramic Ware

(SPECIALLY CONTRIBUTED)

EVERY ceramist is familiar with the fact that the atmosphere inside his kiln is likely to exert an important effect on the nature of the final product. In presenting a résumé of the effects of variations in kiln atmospheres it is convenient to divide them into the following groups according to the effects on:

(a) biscuit firing;
(b) glost firing;
(c) enamel firing.

Types of ware which receive only one fire can either be included under one of the above headings or be treated separately.

Objects of Biscuit Firing

The objects of biscuit firing are:

(a) to remove water used in manufacture;
(b) to "burn" away carbonaceous matter and to decompose carbonates, sulphides, etc.;
(c) to bring about those chemical changes which result in the production of a mechanically strong article suitable for glazing and if necessary, decorating.

Removal of Water

Clay ware as set in the kilns always contains mechanically held water. With articles such as bricks, pipes, and tiles the amount is greater than with, e.g., pottery, which is dried much more thoroughly before setting. Thus pottery may be dried down to about 5 per cent., while bricks may contain up to 10 per cent. water depending on the efficiency of drying. In exceptional cases with certain brick clays made by dry pressing the moisture content of the bricks as set in the kiln is around 18 per cent. These differences result in different firing times as the moisture must be taken off slowly.

The aim in these early firing stages should be to prevent condensation on the ware, because this can cause it to lose its shape ("morted") or, if there are sulphur oxides in the gases in the kiln (from sulphur compounds in the fuel) the condensation of sulphuric acid on the ware may lead to the formation of sulphates, e.g., $CaSO_4$ on the surface, which may cause scumming

Condensation of sulphuric acid may also lead to iron speckling. The mechanism of this is the formation of iron sulphate with iron compounds which are normally distributed in small amounts in the clay. Subsequent evaporation collects the iron sulphate solution into a restricted area, and finally decomposition to iron oxide takes place. The result is that whereas in the normal way the clay would fire to a uniform colour, it is now speckled with spots of iron compounds.

G. A. Loomis (*J. Amer. Ceram. Soc.* **13**, 871, 1930) has ascribed certain brown stains in biscuit ware bedded in sand to reduction of iron compounds in the sand due to reducing conditions in the saggar. This condensation is prevented by encouraging a good draught of air through the kiln and by ensuring sufficient heat to keep all parts of the kiln at a higher temperature than the dew point (cf. L. Bullins *Trans. Brit. Ceram. Soc.* **35**, 54, 1936).

Oxidation of Carbon

At a later stage in the firing, oxidation of the carbon takes place, and this period of the firing is often called the oxidation period. Its limits are often given as roughly 500°-800° C. but actually carbon begins to oxidise at a lower temperature than this. At the same time the clay molecule decomposes giving off steam in the "dehydration period" (cf. Dale and Francis

ibid. **42,** 42, 1942-3). This may hinder the oxidation of carbon unless plenty of air is available to sweep out the steam.

With ware high in carbon, e.g. firebricks, trials are removed from the oven to follow the burning out of the carbon, and the temperature is held back until it is burnt out to prevent vitrification occurring and sealing it in the ware. Insufficient air at this stage may give whiteware a greyish tinge.

Black Cores and Pink Hearts

With other types of ware we may get black cores in bricks or pink centres in buff tiles. Black cores in bricks are caused by unburnt carbon and also by the formation of ferrous silicate by reduction of the iron compounds present in the clay. Ferrous compounds fuse at comparatively low temperatures giving a certain amount of vitrification. Pink centres in buff tiles are considered to be due initially to the presence of unburnt carbon. This prevents bleaching of the red iron compounds by the alumina in the body. This reaction is supposed to take place over a comparatively low temperature range so that when the carbon is subsequently burnt out at a higher temperature the red centre remains (cf. J. W. Mellor, *Trans. Brit. Ceram. Soc.* **32,** 423, 1933).

Blue Bricks and Tiles

For some purposes the kiln atmosphere is deliberately made reducing. A. Dinsdale and M. Francis (*ibid* **44,** 1, 1945) have shown that reducing atmospheres are produced periodically in an intermittent kiln when the fire mouths are filled with coal in "batting." This is done deliberately to produce the well-known Staffordshire blue bricks and tiles, which, because of the fluxing power of the ferrous compounds, are very strong, the bricks being used for engineering work.

In the manufacture of Continental porcelain too, the last stages of fire are made deliberately in a reducing atmosphere. In the bottle ovens this is done by producing smoke, and in tunnel ovens by maintaining a curtain of reducing gas in part of the tunnel. The purpose is to produce whiteness in the ware. The iron compounds which normally produce a yellowish

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tint are partly reduced to blue ferrous compounds, and the combination of blue and yellow produces white. The use of small traces of blue stain in washing clothes and as an addition to whiteware bodies are further examples of the use of complementary colours to produce whiteness.

Effect of Kiln Atmosphere on Strength

It appears that the kiln atmosphere can have some effect on the strength of some fired bodies. Thus A. M. Hassenlopp and R. Russell jnr. (*J. Amer. Ceram. Soc.* **18,** 204, 1935) studied the effect of firing a high mullite porcelain body in various atmospheres and in vacuum. The body was fired in oxidising conditions to 1,000° C. and thereafter in either oxygen, nitrogen, carbon dioxide, or vacuum. The effect on density and vitrification range was then noted. Oxidising fire in all stages was best for high density. Vacuum lowered the vitrification temperature and increased the vitrification range.

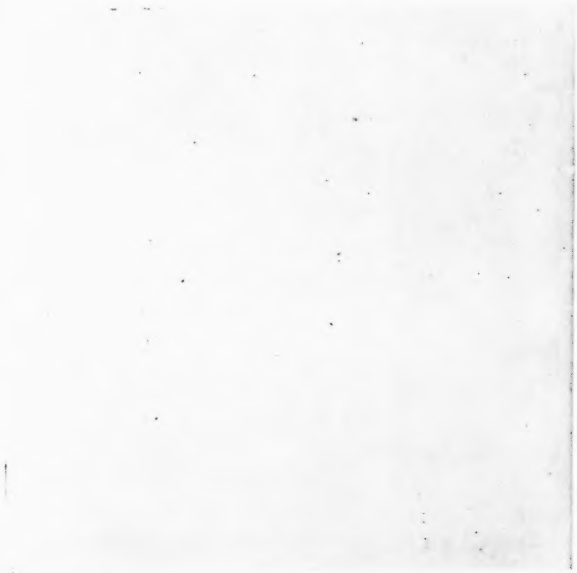
Blackened Glaze

In firing glost the effect of the atmosphere depends to some extent on the glaze. Obviously reducing conditions in firing lead glazes will lead to blackening of the glaze due to reduction of the lead compounds to metallic lead. This condition may be general due to a smoky atmosphere or to one containing carbon monoxide due to insufficient air being admitted, or it may arise locally from accidental penetration of oil into the glaze—particularly as a result of decoration. The latter will of course appear in the decorating fire.

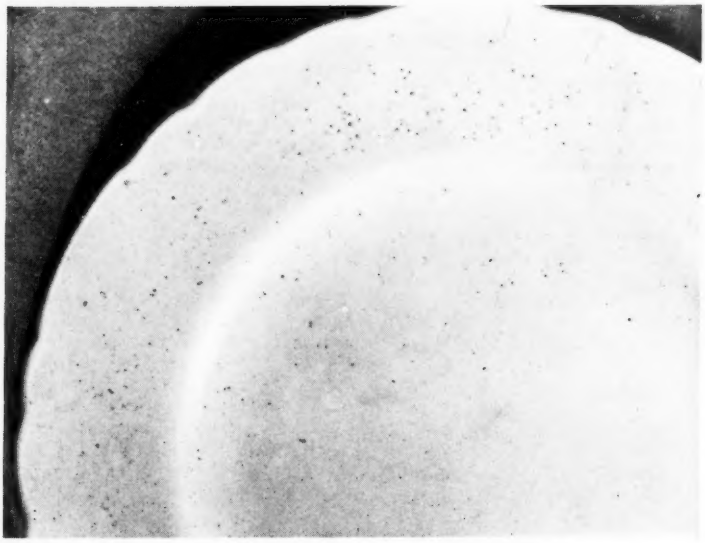
Starring and Feathering

Perhaps the most common fault arising from atmospheric conditions in the glost kiln is the formation of crystals on the glaze surface giving what is called "starring and feathering." This arises from the formation of sulphates on the surface of the ware in the later stages of glost firing due to the presence of sulphur dioxide in the kiln gases (cf. J. W. Mellor, *Trans. Ceram. Soc.* **5,** 87, 1906; **6,** 71, 1907). The latter arises from sulphur compounds in the coal.

A similar fault due to crystallisation of silicates, etc., from the glaze can occur even in a clean kiln atmosphere and is called "aired ware." This is due to admission of air to part of the kiln to keep its temperature back while the other portion is being got up. If as a result of this the kiln temperature is



Glazed tile showing poor surface due to action of sulphur gases



Section of a plate showing "spit out"

maintained at around 700° C. then the conditions are favourable for crystallisation of the glaze. This fault is often confused with "sulphuring."

Saggaring of ware is essential in glost firing in intermittent ovens as a protection against sulphur gases arising from the combustion of the fuel. With the use of electric tunnel ovens, where the atmosphere is free from these impurities, the use of saggars is not necessary. Town's gas is so low in sulphur compounds that for many purposes glost ware can also be open set in this case too.

Lustres by Reduction

Glost firing under reducing conditions is done deliberately to produce some coloured glazes and lustres (cf. L. Franchit, *Trans. Brit. Ceram. Soc.* **7,** 71, 1907-8). Thus by firing a glaze containing copper oxide and letting it cool in a reducing atmosphere the magnificent in-glaze copper reds (*sang-de-boeuf*) can be obtained. The colour is supposed to be due to the formation of red coloured particles of colloidal copper in the glaze. Using other metals such as bismuth, silver, etc., and reducing in the same way a series of coloured in-glaze lustres can be obtained. There have been in the past various materials recommended for the reduction but Franchet has shown that coal gas is easier to use and quite as effective (cf. CERAMICS, **2,** 621, 1951).

Perhaps easier to produce are the on-glaze copper reds (*rouge flambé*). They are obtained by coating the glaze with a paste of a reducible copper compound and clay, and then reducing for a short time at a temperature of approximately 650° C. The final effect varies with the temperature and duration of reduction. Nowadays a great deal of lustre work is produced not by using a reducing atmosphere, but by incorporating easily reducible compounds, e.g. resinates in a mixture which is applied by a brush. In firing carbonisation of the oil, etc., occurs producing local reducing conditions.

Enamel Kiln Firing

Most enamel or decorating firing is now done by electric kiln and consequently losses due to kiln atmosphere are less than when the intermittent muffle kiln was used with the constant danger of leakage of gases through a cracked muffle wall.

It is in the enamel kiln too, that the

results of previous troubles may become apparent, and this after a lot of expensive decoration has been applied. "Spit-out" is a case in point.

There is more than one theory and probably more than one cause of this fault, which as most of our readers will be aware, denotes a crop of small bubbles in the glaze, which subsequently break, leaving a rough surface which picks up dirt readily. In some of the theories which have been advanced to account for "spit out" the kiln atmosphere plays an important rôle (cf. J. W. Mellor and B. Moore (*Trans. Brit. Ceram. Soc.* **7**, 1, 1907-8)).

Sulphur Dioxide

Thus in one theory "spit out" is supposed to be caused by bubbles of sulphur dioxide escaping from the glaze. The dioxide is formed from the combustion of the fuel in glost fire or by the oils in badly ventilated enamel kilns reducing sulphates present in the glaze. The sulphur dioxide is normally soluble in the glaze, and the solubility is decreased if the glaze dissolves silica from the body. It is thus postulated that during the firing the change in glaze composition can result in liberation of sulphur dioxide giving spit out. There are objections to this theory, the chief being that it seems difficult to see why the glaze should react with the body at the low temperature of the enamel kiln.

Another theory which is linked with kiln atmosphere is that "spit out" is due to incomplete burning out of carbon in the biscuit stage, followed by oxidation in glost firing, the bubbles of carbon dioxide being subsequently released as "spit out" in the enamel fire. Thus spit out might follow in an oxidising atmosphere in the enamel kiln. There are again objections to this theory.

Condition of Body

The modern tendency is to recognise that there is no one theory which can explain all causes of "spit out." The condition of the body is now considered more important than that of the glaze and adsorbed moisture may be an important cause. On this view the atmosphere in enamel firing ceases to be a prime cause of trouble (cf. D. A. Holdridge *ibid* **49**, 1, 1950).

Effect on Colours

The effect of kiln atmosphere on colours and decorations merits a brief mention. Generally speaking the preparation of ceramic colours renders them chemically inert. There are, however, certain exceptions.

Coral reds based on lead chromate are susceptible to reducing atmospheres, the result being a greenish colour resembling the patina on bronze statues. This is used at times for decorating figures. Chrome greens are susceptible to oxidation and this is one of the causes of browning with certain types of greens.

Condensation of sulphuric acid on oven blues in the glost fire has on occasion led to solution of the cobalt oxide followed by running of the colour. The flowing of cobalt blues and chrome greens is another effect of atmosphere produced in a limited space by generating chlorine inside a saggar by the use of a flowing powder.

Vitreous Enamels

When we come to vitreous enamels we have to consider the effect of kiln atmosphere on both the enamel and the metal underneath. The so-called "biscuit" of the vitreous enameller is the metal with the dried, but unfired, enamel on it. The actual firing is similar to the potters glost fire except that it is carried out at a very much lower temperature.

The effect of furnace atmosphere on enamels has been summarised by G. H. McIntyre (*A Manual of Porcelain Enamelling*, Cleveland, 1937, ch. 19). He points out that about 1 lb. of water is vapourised into the firing zone for every 100 lb. of dry enamel fired and that if this is not removed by ventilation the concentration of water vapour in the muffle may exceed 10 per cent. Water vapour and sulphur dioxide from combustion of fuel may also leak into the furnace. Fuel oils containing less than 0·5 per cent. sulphur are recommended for enamelling especially as muffles are frequently not gas tight.

This author then describes the work of various investigators on the effect

of furnace atmospheres on the enamels. Thus A. I. Andrews and E. A. Hertzell (*J. Amer. Ceram. Soc.* **13,** 522, 1930) showed that sulphur dioxide had a deleterious effect on enamels, S. E. Ryder and G. N. Culshaw (*Bull. Inst. Vit. Enamellers* **2,** No. 1 1949) have substantiated this and concluded that scumming is caused by sulphate formation.

Effect of Steam on Enamels

The effect of steam on enamels has been the subject of several investigations. H. E. Ebright and G. H. McIntyre (*Enamellist,* **10,** 11, 1933 cf. also Ebright, McIntyre and J. T. Crivin (*J. Amer. Ceram. Soc.* **18,** 297, 1935) showed that a moisture content of 10 per cent. by volume in the firing zone will usually cause trouble from blistering and copper heading, and leads to a poor surface finish in wet process enamels. Cases of boiling have also been noted with ware fired in the presence of steam. Poor surface texture is also obtained with concentrations of acid gases in excess of 4 per cent. by volume in the firing zone. The gases include carbon dioxide, oxides of nitrogen, fluorides and silico fluorides.

1951-52 LECTURES

THE following lectures have been arranged by the British Pottery Managers' and Officials' Association to cover the 1951-52 session. These will be held on the dates stated, at 7.45 p.m. in the North Staffordshire Technical College:

1st October, 1951. Dr. Wilfred Coxon, M.Sc., F.R.I.C., F.I.M., editor CERAMICS — Science, Industry and Politics.

5th November, 1951. Mr. Stanley Hind, consulting ceramic engineer—The Firing of Pottery in Tunnel Ovens.

7th January, 1952. Mr. H. L. Podmore, B.Sc., F.R.I.C., director, W. Podmore and Sons Ltd.—The Controlled Milling of Ceramic Materials.

4th February, 1952. Mr. Cuthbert Bailey, director, Doulton and Co. Ltd.—The Heart of The Matter.

3rd March, 1952. Colonel N. W. Elliott, J.P., governing director, Samuel Radford Ltd.—Nationalised Industry and the Powers of Parliament.

Lectures on Refractories. — Their Manufacture, Properties and Uses, will be delivered by L. R. Barrett, M.A., B.Sc., A.R.I.C., M.Inst.F. at the Northampton Polytechnic during the 1951-52 session, on Tuesday evenings at 7 p.m. commencing on 2nd October, 1951. Full particulars from J. E. Richardson, Ph.D., B. Eng., M.I.E.E., A.M.I.Mech.E., Principal, Northampton Polytechnic, St. John Street, London, E.C.1.

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Works Planning for Extension and Development

by A. E. HEWITT

INTRODUCING his paper, under the above title, to a meeting of the British Pottery Managers' and Officials' Association, at the North Staffordshire Technical College, on the 3rd September, 1951, Mr. A. E. Hewitt of W. T. Copeland and Sons Ltd., said that one of the first injunctions given him by his father when he started in business on his own was that in business you cannot stand still: you must either go forward or you slip backwards. He thought that this was particularly true with regard to the pottery industry since the end of the first World War.

Continuing Mr. Hewitt said:

The Spirit of Enterprise

One of the greatest attributes in the character of a Briton, and the main reason in the past for our dominant position in the world, is our spirit of enterprise. America, all our Dominions, and most of our Colonies were founded by enterprising Britons who were dissatisfied with the conditions here. They may have been younger sons of a large family. They may have had relations who were too comfortably off and too complacent, or they may just have had the wanderlust and wanted to start up for themselves.

Many of our forebears in the pottery industry were far too complacent—life was easy, food and drink were cheap. There were no motorcars, there was little travelling. They lived in a very narrow and circumscribed corner of this island, and the only enterprise which some of them developed was that of copying their neighbours' patterns and cutting their prices.

40 Years Ago

There is an old tale of the conditions in the Longton china trade 40 years ago, when business was very poor. Few were making money, and prices were most unremunerative. An Association meeting was called and it was decided that they would get out the costs of what was then the staple line—white and gold sprig. There was only one firm capable of getting out these costs and they were quite willing for an independent auditor to obtain them. The Association decided, amongst other matters, that white and gold teas should not be sold below 2s. 6d. per dozen. The notice went out to all the customers. Before many weeks had passed, it was found that one firm were still selling these teas at 2s. 4d. The proprietor was called before the Association to give an explanation, which was . . . "I walk to my factory. Mr. . . . drives down to his in a carriage and pair—that's worth 2d. per dozen, isn't it?"

I am assuming, however, that every one of you here is enterprising in the right manner; otherwise you would not be members of this excellent Association. Under-managers want to be managers; managers want to be officials, and officials want to be directors. Keep that ideal in front of you, and some of us will be retiring and drawing the dividends you are going to make for us.

Reasons for Development

Before your firm starts thinking of extending and developing, you must be quite clear in your own mind just what they want. Their decision will have to be made on any one or other of the reasons given below:

(1) The desire to improve quality (never more essential, etc.).

(2) The desire to improve quantity (to meet foreign competition, etc. Sellers market, etc.).

(3) The desire to improve conditions for their operatives (less carrying, etc.).

(4) The hope of producing more cheaply (less carrying; plastics; foreign competition).

(5) The hope that they are going to make money, or more money.

Do not let your firm change their minds, because if their decision is that they want quantity and cheapness your plans will be quite different from those if they decide they want quality.

Improvement of Conditions

Most enlightened firms now realise that their operatives are human beings. Workshops have to be designed to conform to the minimum conditions laid down by the new Factory Acts, so that whether you are going to lay out your extensions for quantity, quality, or cheapness of production, these Regulations must be borne in mind. They were originally drafted by the Committee of the old National Council, consisting of both manufacturers, managers, operatives, and representatives of the various Departments of the Ministry of Labour, including the Factory Inspectors.

It took 2-3 years to draft these Regulations and they were built up on the knowledge gained by many years' experience, but they were *minimum* regulations—not maximum, and if, as individuals, any of you can improve on them, by all means do so—H.M. Inspectors will not object—in fact I suggest that you consult them as often as possible.

When your principals have made up their minds *why* they are going to develop, you, as individual managers, must make up your minds *how* you would like your own particular department to look when it is all finished.

A Planning Committee

My suggestion is that you ask for a planning committee, consisting of your senior managers and officials. They should be responsible to the Board of Directors but have a free hand to prepare the detailed schemes for each section of the plan. This method is one of the best ways of ensuring that potentially sound schemes are not marred in practice by lack of attention to details. Such a committee should be free to make recommendations and to offer advice from the very earliest days.

It is the manager's duty to check that all general schemes are in fact going to show the improvements hoped for. Through the planning committee he can be sure that such things as flow of ware through individual departments is as near to the ideal as possible. He can check that operatives will have sufficient light for the job they are doing, and that the best type of artificial light is used for any particular job. He can voice his his opinion on stillard trucks v. conveyors, and suggest that a lift would save carrying. That his present shop is too hot in the summer and too draughty in the winter, and press for better ventilation; why not have lavatories in this corner, and what about a hot water urn for tea in that corner or passage.

In fact, it is the chance for him to benefit his firm and himself by making practical use of the knowledge and the experience which daily contact with departmental troubles, has given to him.

Knowledge and experience are of no value unless put to practical use, and managers should do all in their power to see that full advantage is taken by those responsible for making the final decisions, through the official medium of a planning committee or through more unofficial channels.

A Team Result

Senior managers, in their turn, should make full use of under-managers and foremen, who should be informed of the firm's intentions in the earliest stages of the proposals. Their advice and comments should be noted and related to the general plan. Large official committees are unwieldy and make for slow progress, but any factory extensions and developments, when complete, should be the result of the joint skill, knowledge and experience of a very large number of employees of all grades, and it is the managers who must see that ideas flow down the correct channels to be translated into bricks and mortar, plant and machinery, better conditions and more economical working.

Ask your principals what their

ideas are, and then persuade them to leave you alone for a few months to incorporate your own. Most of the extensions and developments which are going on now are because of the changeover from intermittent to continuous firing, so that long before your directors call in their architects, you and they have to decide on the type and size of the tunnels and kilns which you are going to have, and always assuming that there is plenty of room and space, your extensions have to be planned around the tunnels.

The decision on this major problem alone will take a few months, and because of the very nature of continuous firing as opposed to intermittent, the whole routine of your factory practice may have to be changed.

Personally, I am never too much hurt if my staff amend and alter my original conceptions. They most likely know a great deal more than I do about their own particular departments, and in many cases I find their suggestions are better than my own.

Visit Other Factories

Ask for time off to go and see any new factory or any major alteration which has been carried out during the last few years, and do not confine these visits to factories making only your own class of goods. If you are lucky and are able to persuade your board to send you abroad to visit either the continent or the U.S.A., do so.

Study all the technical literature you can. Try always to have your suggestions ready before your directors think of asking you. If the suggestion is a really good one, take it to them first.

Having, after many months, now made up your mind *how* you would like these extensions carried out, and *how* you would like to do them, and having got your rough plans all argued out with your directors and settled, then and not until then, they will call in an architect.

Choice of an Architect

There are plenty of first-class men in this district—men with ideas, brains, and general experience—most of them having a considerable knowledge of the potting industry. Because a first-class architect is chosen, however, it does not necessarily follow that he knows everything there is to know about boilers, engines, grinding, heating, ventilation, dust extraction, vacuum cleaning, or electrical engineering.

If he has done much factory work, he will have a good general knowledge of all of them, and what he does not know himself he will readily be able to obtain from the right people.

If the extension is a large one, I do suggest that you try to persuade your board to employ a consultant on all these special trades. A few hundred pounds spent on expert advice at this stage may save thousands of pounds later on.

The architect will probably begin by telling you that most of your ideas are impossible from an architectural point of view. They will be far too costly: that you have forgotten this, that, and the other (you probably have!) but this does not matter. Just tell him that is what you and your directors want and it is up to him to get it down on the drawing board and let you see what he makes of it.

Do not be diverted from your original plans except in small details, if you can possibly help it. Remember *you* are the people who will have to make it all work when it is finished, and, in any case, your firm will have to foot the bill.

The First Stage

Having got the main ideas settled with the architects and the various experts, then the planning committee's work will really begin.

If the development and extension is going to take place on a virgin site, your worries and troubles will not be so great as if (as is the case with most of us) it has to be incorporated in your present works.

The first task then is to decide how the old shops can be demolished without losing too much production, and without causing too much dust and general inconvenience. Most services will have to be moved and arrangements made to have them coupled up to the new building. Steam, live and exhaust, return mains, gas mains if you are to have a gas oven, or electric mains for an electric kiln, power and light, ducts for dust extraction, water for process work, drinking pur-

Illustration shows Willett hydraulic plate-making machine feeding a Mitchell flatware dryer.

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poses and lavatories, and of course, sewers and drains.

If the extension is a considerable one, a new boiler and/or a new engine may be necessary, a new electric sub-station, or possibly all three.

You obviously cannot go very far with your services until the new building is up, but you can get your main supply points fixed.

You may have to build a new sliphouse or alter your present sliphouse if it is the production end you are extending. In any case, you must be sure that your present sliphouse is capable of turning out the extra quantity of clay which you may be requiring if you are going to increase your volume of goods.

It is surprising how many of these matters get overlooked.

Access to New Site

Finally, you must be sure that you have access to the new site. You may have to deal with thousands of tons of materials coming on to the works. Many of them will have to be stored; cement, sand, and dust may play Hamlet with your bodies.

Next, fix the position of your machines, dryers, fans, etc., and see how you can service them. You will probably want dust extraction, water pipes, vacuum pipes, compressed air pipes, and you will certainly want some steam.

One of the tips which those of us who were fortunate enough to go to America seized on more than anything else was that arrangements should be made as far as possible for all services to be incorporated in duct, either under the floor, or cased in as part of the building. It may not be possible to do them all, but spend some time and thought trying to arrange for as many as you possibly can.

Be sure that the accommodation in the old part of the building will be capable of dealing with the extra production which you hope to obtain from the new.

Your sliphouse accommodation may be quite insufficient, too. You may find that when you have made all your

ware and got it decorated, your enamel kiln will not be able to take the quantity. Always allow for a percentage increase, but not too much or else all your other schemes may be thrown out of gear.

When all these matters have been decided upon you will find a grateful architect only too pleased to incorporate your ideas with his own. He will indicate all these services in detail on the plans, and your firm will save a lot of expense by not having to knock holes in walls and floors.

The quantity surveyor will now prepare the Bills of Quantities from the architect's finished drawings, and tenders will be invited from various contractors.

Competitive Tenders

Even when you have employed a contractor for years, if the scheme is an extensive one it is always advisable to invite competitive tenders. The variations between the highest and lowest tender has been known to be as much as 25-30 per cent.

It is for your Board of Directors to decide to whom the tender shall be given, but they may ask your help and advice; your own knowledge of the work they have done elsewhere, the type of agents and foremen they employ, and whether they have a full order book will all be valuable.

When considering tenders, it should be remembered that probably as much as half the work is given out to specialist sub-contractors, and if particular types of work are specified—piling or roofing, heating, lighting—probably the sub-contractors estimates to the main contractor are all exactly the same.

If there are delays (and there will be plenty!) the main contractor generally says that it is the sub-contractors who have let him down, but it is his job to see that this does not happen. He is the man who is responsible to your Board and it is up to you to apply the pressure on him, and not grouse to the sub-contractors.

Having had the plans passed by the Town Planning Authority and six or seven other Ministries, and your directors having signed the contract, your main job is then about half done. If it is a large and expensive job, ask your Board to have their own clerk of works, not to spy on the contractor necessarily, but just to see that there is no shoddy work being done and no extras are being put in.

I think it is always a good idea, when the main contract is signed, to send an accompanying letter stating that no alterations of any kind are to be made to buildings or plans without the written authority of the architects or your managing director. It is so easy, when going round the new place, to realise that you have made a few mistakes. Have them altered, by all means, but get your director or architect to agree, and have it put in writing, or else. . . .

If it is your particular responsibility, tactfully suggest to your brother managers and your directors that they should not criticise the detailed work too much in its various stages. Ask them to wait until the work is finished.

Avoid Maintenance Costs

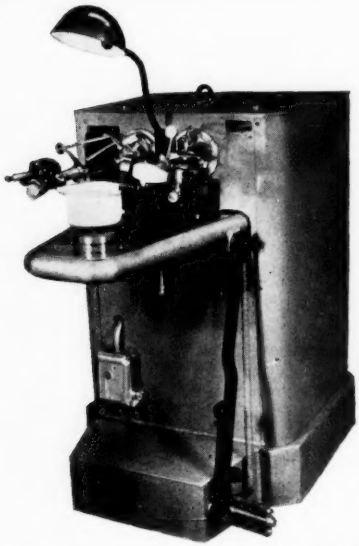
When you are drawing up the plans, think of everything you can to avoid maintenance costs once the works is built; use concrete or aluminium wherever you can for everything, even including your window frames—they never want painting. If you have large areas of glass, think of window cleaning, and arrange for supplies and taps to be available if there are large numbers of skylights. You cannot expect the window cleaners to use buckets of water over the acres of glass which there are on some of the new factories.

I hope this talk will have given all of you something to think about—that you will realise that to be good managers you have very many matters to think about in addition to the technical details of your own departments.

Discuss your problems with each other whenever you have your meetings—never be frightened of asking for information and never be diffident in giving it.

The potting industry is one of the oldest in the world; until a few years ago it was one of the most backward. Today it is one of the most go-ahead and it always has been one of the most fascinating and interesting.

Acheson Colloids Ltd.—Mr. A. Cheney B.Sc., the northern counties engineer of Acheson Colloids Ltd., London, manufacturers of the well-known "dag" dispersions, has moved to his new office at 7 Hunters Lane, Rochdale.



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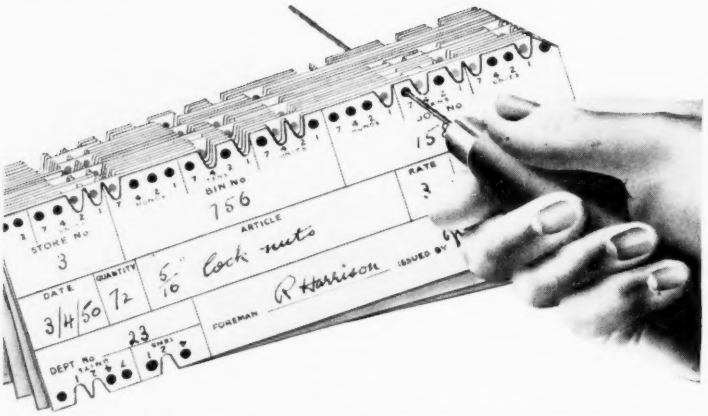
Punch Card Coding for Research Records

RECENTLY we visited the new laboratories of the National Benzole Association near Watford and noticed the use to which the Copeland Chatterson Paramount sorting system is put. The information is entered on to the cards and correlated to the system of holes punched round the edge; when the batch of cards is held together and a needle inserted through a hole corresponding to the information required the cards carrying this information drop out. Typical examples of what can be found are, all compounds with a boiling point range of say, 70°-90° C., compounds containing twelve carbon atoms and so on. The system is widely used for the indexing of abstracts from periodicals, and the following illustration gives an indication of the system.

From the librarians' viewpoint when publications enter the library he can scan through them and code the designation of each article for which a card is planned. As the publications circulate through the staff, each research worker has an opportunity to revise and add to from a convenient work-book classifying the appropriate headings and the code symbols. The research worker, seeing an article worthy of indexing puts a note in the margin corresponding to the substance of the article. Procedure can be varied for abstract bulletins. It is possible to design cards to cover a variety of



The Copeland Chatterson "Paramount" hand-operated punched card sorting system. Illustration shows stores requisitions being needled against job number

new purposes as well as making use of a standard one.

However, like all good things the method can be overloaded when the number of cards can become too unwieldy. Thus it would seem desirable at the beginning to limit the selection of cards to those purposes for which there is likely to be a consistent demand and to group them in such a manner that within each group the possibility of them becoming unwieldy does not arise.

Obviously the success of the system does depend upon a very close liaison between the librarian himself and the research investigators who will use the system.

There is considerable room for this kind of index system in circumstances where it can be used economically and conveniently.

The Copeland Chatterson Co. Ltd., of Exchange House, Old Change, London, E.C.4, have devised a system for bibliographic abstracts and general records, and in the design of their standard abstract card they have managed to get in a considerable number of codings on the standard card.

By way of explanation, each hole on the card represents an item of information which is identified by a number or lettered code. As soon as this information is entered on the card the relevant hole is slotted with a pair of nippers. Thus, when the needle is inserted through a batch of cards and the batch is raised, those which have been slotted fall away.

In their booklet the coding system is fully explained and formulæ are given to show the number of codes available for two, three and four hole codes, which respectively amount to 3,081, 76,076 and 1,436,425 if all the 78 holes are used. However, it is often desirable to split the 78 holes into different fields such as authors, nationality, main subject, sub-division. The system of course lends itself to the rapid determination of figures and data in many businesses and professional activities, and it is simple to use.

Belgian Bricks Imported. — Belgian bricks have been imported to Scotland to meet the shortage. This revival of pre-war trading was undertaken by Charles Tennant and Co. Ltd., of Hillington. Alexandra Transport Co. Ltd., brick-makers, quarrymasters and builders' merchants also took supplies in August and announced that Belgian deliveries would be at the scale of one million bricks per week. These will be used for housing scheme purposes at Clydebank.

The Economics of Thermal Insulation in Building Construction

by

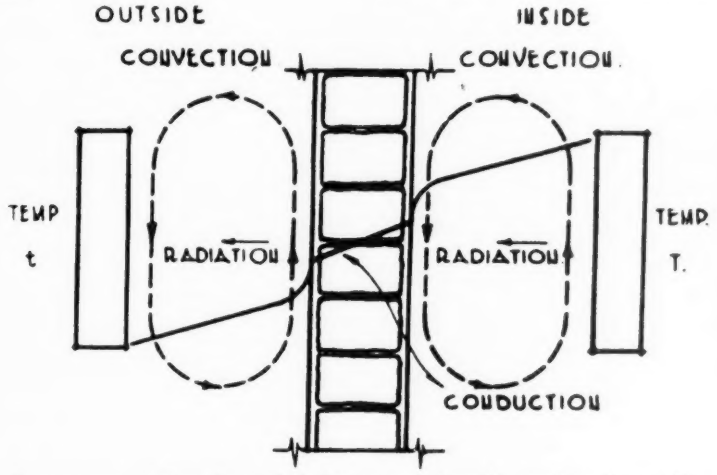
C. W. GLOVER, M.I.C.E., M.I.Struct.E.

(Past President, Incorporated Association of Architects and Surveyors)

THAT it is desirable in modern buildings to secure the maximum insulation against the vagaries of the weather, the transmission of vibration and noise and the loss of heat has long since been accepted, but few realise the economic necessity of providing such insulation. The use of the minimum of material in wall panels in framed buildings necessitates the application of the latest principles of insulated construction, and the following general notes, together with data on typical details, should be of assistance to the designer.

Summary of a paper produced for a conference on Heat Insulation, under the auspices of the Joint Committee on Materials and their Testing, in conjunction with the Institution of Gas Engineers.

The present demand for the elimination of waste emphasises the need for the minimisation of heat loss by the provision of improved thermal insulation. This is usually effected by the use of special materials or forms of construction, or both, by which the passage of heat is resisted. Heat transmission is best understood by considering the effects of radiation, convection and conduction generally, as depicted in Fig. 1. Heat is conveyed from the warm objects inside by radiation and convection to the inner wall surface, thence by conduction through the material of the wall, and finally by radiation and convection of the air outside. The process of heat transmission through composite and insulated construction



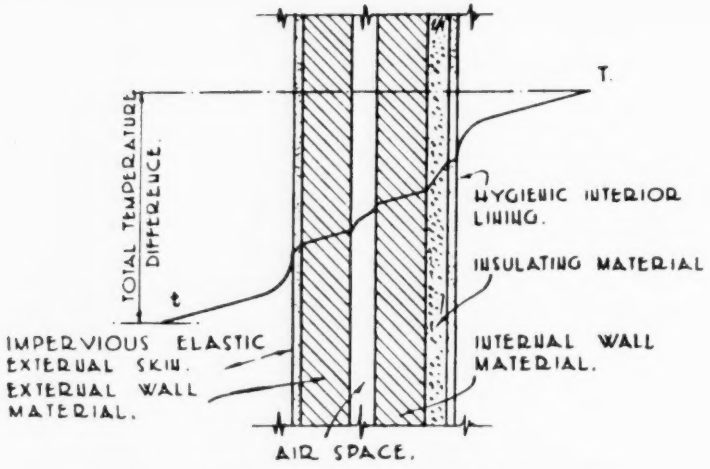
Temperature gradient from air inside to and through a wall to air outside. The direct passage of air through the wall is neglected

Cost—Efficiency Analysis of Wall Construction

Construction	*Approx. Cost per sq. ft.*	*Heat Transmitted per hour per sq. ft. per °F. temp. diff.*	*Thermal Insulation Cost Coeff.*	*Estimated Sound Insulation of Construction in decibels*	*Cost per sq. ft. per decibel of Insulation*	*Heat and Sound Insulation Cost Coeff.*	*Weather Insulation Efficiency*	*Weather Insulation Cost Coefficient*	*Heat, Sound and Weather Cost Coefficient*	*Sound Absorption in O.W.U. per sq. ft. of Interior Surface*	*Cost per sq. ft. per O.W.U.*
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*
	Cost s. d.	*B.Th.U.*	*Cost Coeff.*	*db.*	*Cost per db.*	*Coeff.*	*W.I.U.*	*Coeff.*	*Coeff.*	*O.W.U.*	*Cost per O.W.U.* s. d.
4½ in. brick. No finish	1 1	0·53	6·9	50	0·26	1·79	10	1·3	2·3	0·031	34 11½
4½ in. brick rendered cement outside. ¾ in. ordinary plaster inside ...	1 4	0·43	6·9	55	0·29	2·001	40	0·4	0·8	0·025	53 4
4½ in. brick rendered cement outside. ¾ in. Dekoosto plaster inside ...	2 8	0·37	8·7	55	0·58	5·046	40	0·85	4·3	0·30	8 10½
9 in. brick. No finish	1 8½	0·36	7·38	53	0·38	2·804	26	0·79	2·2	0·031	55 1
9 in. brick rendered cement outside. ¾ in. ordinary plaster inside ...	1 11½	0·31	7·18	58	0·40	2·87	50	0·47	1·35	0·025	78 4
9 in. brick rendered cement outside. ¾ in. Dekoosto plaster inside ...	3 4	0·27	14·8	58	0·68	10·06	50	0·8	8·05	0·30	11 1
14 in. brick. No finish	2 5	0·27	7·83	57	0·508	3·97	42	0·69	2·74	0·031	78 0
14 in. brick rendered cement outside. ¾ in. ordinary plaster inside ...	2 8	0·24	7·68	62	0·516	3·96	60	0·53	2·1	0·025	106 8
14 in. brick rendered cement outside. ¾ in. Dekoosto plaster inside ...	4 0½	0·22	10·67	62	0·78	8·32	60	0·81	6·75	0·30	13 6
18 in. brick. No finish	2 11½	0·22	7·81	58	0·61	4·76	60	0·6	2·86	0·031	95 5
18 in. brick rendered cement outside. ¾ in. ordinary plaster inside ...	3 4	0·20	8·0	66	0·60	4.8	70	0·57	2·74	0·025	133 4
18 in. brick rendered cement outside. ¾ in. Dekoosto plaster inside ...	4 8½	0·18	10·17	66	0·856	8·7	70	0·81	7·0	0·30	15 8
2 in. precast concrete slab. 7 in. reinforced concrete. 2 in. cork. ¾ in. plaster	4 3	0·11	5·6	83	0·61	3·42	80	0·64	2·2	0·03	141 8
2 in. precast concrete slab. 7 in. reinforced concrete. 2 in. Heraklith. ¾ in. plaster	4 0	0·15	7·2	85	0·57	4·10	80	0·6	2·46	0·03	133 4

Cost—Efficiency Analysis of Wall Construction

Construction	*A* Approx. Cost per sq. ft. Cost s. d.	*B* Heat Transmitted per hour per sq. ft. per °F. temp. diff. B.Th.U.	*C* Thermal Insulation Cost Coeff. (A × B) Cost Coeff.	*D* Estimated Sound Insulation of Construction in decibels db.	*E* Cost per db.	*F* Heat and Sound Insulation Cost Coeff. (C × E) Coeff.	*G* Weather Insulation Efficiency W.I.U.	*H* Weather Insulation Cost Coefficient (A ÷ G) Coeff.	*J* Heat, Sound and Weather Cost Coefficient (F × H) Coeff.	*K* Sound Absorption in O.W.U. per sq. ft. of Interior Surface O.W.U.	*L* Cost per O.W.U. s. d.
4½ in. brick cement rendering on fibre board outside. Fibre board lining inside	1 8	0·27	5·4	55	0·36	1·94	70	0·29	0·56	0·3	5 6
4½ in. brick cement rendering on fibre board outside. Plaster on fibre board inside	1 9½	0·25	5·4	58	0·37	2·0	70	0·31	0·62	0·03	59 8
9 in. brick cement rendering on fibre board outside. Fibre board lining inside	2 4	0·22	6·2	58	0·48	2·98	75	0·37	1·1	0·3	7 9
9 in. brick cement rendering on fibre board outside. Plaster on fibre board inside	2 5½	0·20	5·9	61	0·48	2·83	75	0·39	1·1	0·03	81 11
Stud partition 1½ quilted kapok each side finished with lath and plaster on battens ...	2 10	0·07	2·4	73	0·46	1·10	—	—	—	0·025	113 4
Stud partition with 1½ quilted kapok each side finished with fibre board on battens each side ...	3 0	0·96	2·2	73	0·49	1·08	—	—	—	0·3	10 0
⅛ in polished plate glass exterior. 6 in. reinforced concrete. 2 in. cork. ½ in. plaster	7 10	0·11	8·6	75	1·25	10·75	90	1·0	10·75	0·03	261 0
⅛ in. polished plate glass exterior. 9 in. brick. ½ in. fibre board on battens. ½ in. plaster ...	7 0	0·15	12·6	73	1·15	14·50	85	1·0	14·5	0·03	233 0
Sheet metal exterior on battens. 3 in. Heraklith. 7 in. air space. 3 in. Heraklith. ½ in. plaster ...	2 10	0·06	2·0	80	0·43	0·86	85	0·4	0·344	0·03	94 5



Temperature gradient through composite insulated construction

can be understood by consideration of Fig. 2. A fairly comprehensive and authoritative list of the thermal conductivity of building materials at normal temperatures is given in a booklet "The Computation of Heat Requirements for Buildings," issued by the Institution of Heating and Ventilating Engineers, and the reader is referred to this document for the coefficient required in heat-loss calculations.

The overall thermal resistance of any construction is simply the sum of the heat resistances of its several parts, and the resistances of surfaces and air spaces. Thus, referring to Fig. 2, we might have a computation generally as below.

The thermal transmittance coefficient U is the reciprocal of the overall resistance, so that for this case $U = 1/6{\cdot}21 = 0{\cdot}161$ B.Th.U. per sq. ft. per hr. per 1° F. difference in temperature, air to air. The hourly heat loss is, of course, this

Thermal Properties of Composite Wall Construction

(1)	External wall resistance, say ... ... (This varies between 0·07 and 0·73 depending upon the orientation and the condition of exposure)	= 0·30
(2)	½ in. waterproof rendering, 0·14/2 ... ... (half that tabulated for 1 in. thickness)	= 0·07
(3)	4 in. of 1 : 2 : 4 R.C. wall slab, 4 × 0·14	= 0·56
(4)	2 in. air space ... ... (tabulated as 1 for emissivity of surface of 0·9 and as 2 for emissivity of 0·1) (half these values for air between corrugated sheeting and adjoining surface in contact with the corrugations).	= 1·00
(5)	4 in. of 1 : 2½ : 7½ foamed slag concrete, 4 × 0·53	= 2·12
(6)	½ in. insulating fibre board, 2·63/2	= 1·31
(7)	½ in. of plaster finish, 0·31/2	= 0·15
(8)	Internal wall resistance	= 0·70
	Total thermal resistance	= 6·21

figure multiplied by the temperature difference and the total area of the construction. The example given illustrates a composite wall of high thermal insulation, but it will be apparent that its cost will also be high.

Consideration of Cost

Cost considered in relation to the thermal insulation is best expressed as a thermal insulation cost coefficient calculated by multiplying the unit cost by the overall thermal transmission *U*. The lower this figure, the cheaper the capital cost of the insulation, and, of course, the lower the *U* figure the cheaper the annual cost of maintaining the specified temperatures against the heat loss through the construction.

On this basis a large range of wall, floor and roof constructions have been worked out and compared on a cost basis, the results being reproduced in tabulated form.

For Plain Construction

The costs given are for plain construction not involving special labours normally measured separately; neither do they take into account the preliminary and other charges that are usually based upon the size of the contract and included in the preliminary bill. The prices tabulated are what would normally be given in bills of quantities for work in the London area under date of Midsummer, 1950.

Of course, this is not the whole story, as other factors have to be taken into consideration.

Some years ago the author drew up a scheme of comparison of building materials and constructions embodying an assessment of all the functional requirements of building elements including structural strength, weather resistance, thermal insulation, sound insulation, fire resistance, etc., but owing to the paucity of reliable information as to the quantitative assessment of the properties of some constructions it was not possible to arrive at an all-round cost-efficiency index.

In utilising the tables reproduced the practitioner is advised to select a few alternative constructions having adequate properties in respect of requirements of strength, etc., and to compare the economics of the thermal insulation provided severally by them.

If the cost of an insulating material itself be not prohibitive, any structural properties it may possess may well contribute to economy in first cost in use.

It is not pretended that the tables are comprehensive, as there are a large number of insulating materials and combinations thereof available. It is hoped, however, that they may be of use for reference and as indicating a method of comparison that can usefully be undertaken by a practitioner, who must, of course, take into consideration any local circumstances that might affect costs.

A STAINED GLASS WINDOW

ORNAMENTAL grisaille style of stained glass was chosen for the new North Wall Choir window dedicated on 23rd September, of Glasgow (Church of Scotland) Cathedral. The style was chosen and developed by Professor A. E. Richardson, London architect and consultant to the Cathedral authorities, and Mr. Carl J. Edwards, chief designer at the Whitefriars glassworks of James Powell and Sons Ltd., Wealdstone.

"Grisaille, which was the universal style in medieval times, was revived in the last century and is having a second revival now," said Professor Richardson. "We hope further to popularise it through this new window, the subtler, delicate shades of which, we feel, blend particularly well with the sharper tones of the pictorial windows elsewhere in the Cathedral."

Size of the window, which was in production at Whitefriars for about a year, is: centre light, 13 ft. high, 2 ft. 7½ in. wide; side lights, each 13 ft. high 1 ft. 9 in. wide. Total height, including tracers, is more than 20 ft.

A FESTIVAL GLASS ANNEALING LEHR

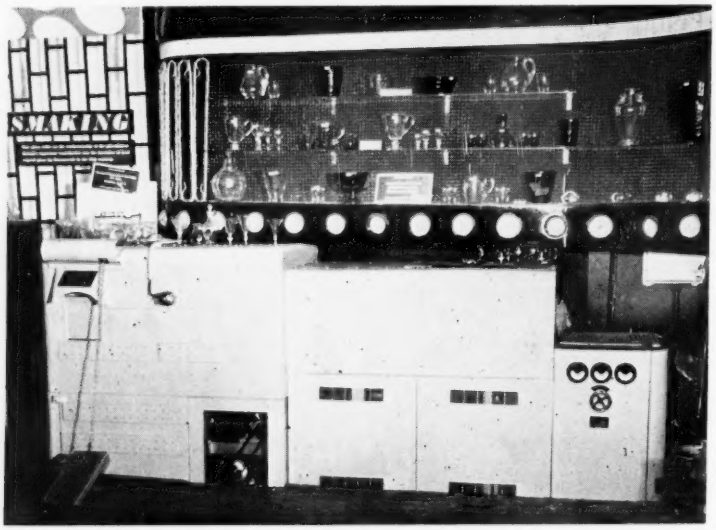
THE design of any furnace, whether it be a small laboratory test kiln or a large continuous production unit, commences with the common factor of output required per unit of working time. These elementary details, with the process or temperature required, lead easily to the decision of overall size, bearing in mind the insulation proportions required by any particular usage.

For a continuous furnace all insulation calculations must be completed for "steady state" conditions. In addition to reducing the ever present external heat losses to a minimum in the interest of economy these calculations may be essential for fine control of falling temperature in subsequent zones.

Time-Temperature Curve

In the annealing of glass the precise control of this falling temperature is the essence of the problem and must follow a predetermined time-temperature curve. It is suggested that the preparation of such treatment data would be of considerable help to ceramists in avoiding many of the worries of performance on the installation of a new kiln or oven. If it is accepted that such a practical curve or treatment will provide the results required the modern precision firing machine can be guaranteed to provide the curve and thus give the desired results.

A performance curve of this type is so essential in lehr and kiln design that, in the absence of information from the customer, any reputable designer prepares a theoretical curve for guidance, based on his own, perhaps more limited knowledge, of the process. In not a few cases such a performance curve and the ultimate design of the furnace may be greatly



Glass annealing lehr by Webcot Ltd. at the South Bank Exhibition

J.D
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influenced by limitations of space or other external conditions. This was certainly the case with the glass annealing lehr that Webcot Ltd., 14 King Street, Newcastle, Staffs, were asked to supply for the glass making demonstration at the South Bank exhibition.

The ambition of the authorities to include an artistically designed demonstration in the confines of a side stand in the Power and Production building was rewarded by the interest aroused, but imposed physical limitations which set performance problems of no small measure.

The space allocated for the lehr was 12 ft. by 2 ft. 6 in. and, as production requirements called for a placing space 8 in. high on a 10 in. wide conveyor it was impossible to include side heating elements even with the ultra lightweight insulating material used. The circumstances of this demonstration further influenced design in as much as side loading of the glass shapes was considered essential. Such an arrangement required some 15 in. of valuable length which, with 2 ft. open conveyor for unloading, left only 8 ft. 9 in. in which to proportion the heating, annealing and cooling sections. For the glass to be made the annealing cycle of 3 hours required a conveyor speed of only 3 ft. per hour.

Only Standard Equipment

All these preliminary details were discussed with James Powell (Whitefriars) Ltd., the demonstrators, and the Festival organisers before the preparation of the proposed annealing curve. The ultimate design would not have been possible without the co-operation of the various suppliers to whom the manufacturers are indebted for the execution and special application of their components to meet the requirements. These components will be dealt with in relation to their function in the lehr, but to install the working components of a 50 ft. to 80 ft. long lehr into the space allotted was a considerable achievement on their part. In view of the siting and use of the lehr it was impossible to contemplate any servicing during the

course of the exhibition and it was a brave decision on the part of all the manufacturers to include only standard equipment and design principles to prove their reliability.

The main framework of the lehr is light steel angle and sheet enclosing lightweight insulation by the Derbyshire Silica Firebrick Co. Ltd. and Stillite Ltd. The general appearance, as can be seen from the illustration, is both effective and pleasing with the cream heat-resisting enamel finish well up to exhibition standard.

Heating elements to raise and hold the annealing temperature of 460° C. to 570° C. are of the Webcot "Easichange" type wound from Hydra 80/20 resistance wire. Large diameter leads run through the furnace walls to the flush, ventilated terminal boxes where all series connections are made with Monel metal clamps and flexible braided connectors. By special element design and disposition adequate temperature uniformity within ± 5° C. was attained with heating elements placed above and below the ware.

In view of the short length and the probability of external draughts, adjustable asbestos curtains were fitted in the lehr. The maximum electric loading of 20 kws. was controlled by a new robust heavy duty temperature regulator by The Industrial Pyrometer Co. Ltd. and, under actual working conditions the consumption appears to be only about half of this figure. This regulator operates mercury relays housed in the base of the lehr with other electrical equipment. Sordoviso Switchgear Ltd., Loughborough, supplied the relays which are standard practice for all Webcot lehrs, and go far to reduce maintenance or service on their equipment. Although rarely needing attention they are readily accessible behind the ventilated base panels, which can be quickly lifted clear by releasing the two spring fasteners with an odd coin from the pocket.

Day to Day Control

Included with the temperature regulator in a small matt ebony board control panel are the Venner time switch for the day-to-day control of the lehr and the motor starter switch which provides overload and no-volt protection for the drive unit. To prevent overheating and damaging the conveyor the switching arrangement is such that the heat cannot be switched on unless the conveyor is running.

The ware to be annealed is loaded on to the preheated conveyor direct from making through the foot operated side loading door and passes slowly down the tunnel to be heat treated in accordance with the predetermined time temperature curve.

Conveyor Drive

Typical of Webcot installations the conveyor drive comprises an electric Vari-speed unit with a Heliocentric reduction gear. When fitted to the standard lehr a speed indicator and infinitely variable speed control is included in the main control panel. Due to this infinite speed variation the ideal annealing cycle can be readily selected.

The motive power for the drive is provided by a small D.C. electric motor of which the armature is supplied with a variable voltage from a regulating transformer and rectifier. The particular method of control adopted has been developed by the Electric Construction Co. Ltd., Wolverhampton and enables the motor to produce a constant torque over the full speed range, the horse power falling directly as the speed. The arrangement is exceedingly simple and robust, requiring less attention than the normal variable speed mechanism. Complete and instantaneous control of the belt speed is obtained by a turn of a hand wheel under the ammeters at the unloading end of the lehr.

From the small motor running at zero to 2,000 r.p.m. a Renold standard chain drive is taken to the input shaft of the Heliocentric reduction gear which, because of lack of space, is contained in the rubber covered drive roller. This small roller, of only 12 in. diameter and 13 in. face, turns approximately once per hour with the 45,000-1 (forty-five thousand to one) reduction fitted into it by Sanderson Bros. and Newbould Ltd., Sheffield.

A positive drive motion is passed to the George Lane "Minstretch" thin lehr belt of flat, heat-resisting wire by rubber covered, mangle pressure rollers, and the belt is allowed to run

slack. The extent of this slack can be readily checked through the toughened glass panel behind which can be seen the Heliocentric reduction gear referred to. The drive unit in the demonstration lehr was retained at the front of the lehr in accordance with the makers' standard practice, although the many advantages are not so obvious in such a short tunnel.

This small but effective conveyor drive is, we would say, one of the outstanding features of the lehr, and has already aroused considerable interest.

Ammeters housed in the end bottom panel indicate the electric current flowing at any time, and it is not until one notices these that it is realised that the lehr is heated by electricity. The complete absence of any wires, conduits or trunking, except that for the pyrometer thermocouple, appears so natural that they are not missed until attention is drawn to their absence.

The lehr has, to date, repaid all the thought given to the original design and has provided the results required without service or attention. The writer is indebted to James Powell (Whitefriars) Ltd., for the considerable help given with the initial design for the lehr and to Webcot Ltd., for permission to quote from their design records.

*p*H MEASUREMENT FOR CERAMIC MANUFACTURE

*p*H MEASURING devices, show the degree of acidity or alkalinity of aqueous solutions and are extensively used in a variety of industrial and scientific applications.

In the ceramics industry it is being increasingly recognised that a number of important physical properties are dependent on the *p*H value of the composition. Clay consists mainly of hydrated alumina and silica. The alumina is weakly basic and the silica weakly acidic. Small amounts of acids or alkalis when added to clay suspensions can vary the hydrogen ion concentration and result in appreciable changes in the colloidal solution. Clays on treatment with water generally give extracts of *p*H 4-5, which suggests that the soluble portions are basic aluminium salts. Clay may be regarded as composed of more or less insoluble nuclei, surrounded by a colloidal film containing silica, alumina, basic aluminium salts and water. If water is added to clay it becomes increasingly plastic until a stage is reached when a suspension known as clay slip is produced. Clay slips are used in the manufacure of articles by casting.

Plasticity depends on the nature of

Exploded view of electrode system

the colloidal film between the particles and this in turn depends on the *p*H value. Addition of small amounts of acid or alkali has a pronounced effect on the viscosity of clay slips and on the plasticity and strength of the dry clay.

Maximum strength occurs in products prepared from slips at *p*H 6, according to some authorities. At *p*H values below 4, aluminium hydroxide begins to dissolve and above *p*H 9 silica is likewise affected. The *p*H of clay slips to be used for casting lies between 5·5 and 9·3—usually the most suitable value is in the lower half of this range. For pure white clay the optimum value is higher and lies just above the neutral point (7 *p*H).

It can be seen, therefore, that the *p*H meter is a valuable means of controlling the viscosity of clay mixes and thus of ensuring desirable properties of strength and texture in the finished product. As an example the Marconi *p*H Meter TF 889 is a practical, general purpose instrument. It is light, portable and robust, yet capable of reliable and accurate measurement even in the hands of an operator without special knowledge. It is battery operated and direct reading over the useful range 1-11 *p*H with a discrimination of 0·05 *p*H.

The electrode system is stowed within a compartment of the case. The standard glass electrode and reference half-cell are mounted in a two-piece moulded rubber assembly; this protects the glasswork and holds a solution in which the glass membrane is immersed to prevent deterioration while the instrument is out of use. The KCl filling arrangement is convenient and the electrodes are easily replaced without the aid of tools. As an alternative a spearpoint glass electrode can be supplied which can be inserted into viscous clay mixtures.

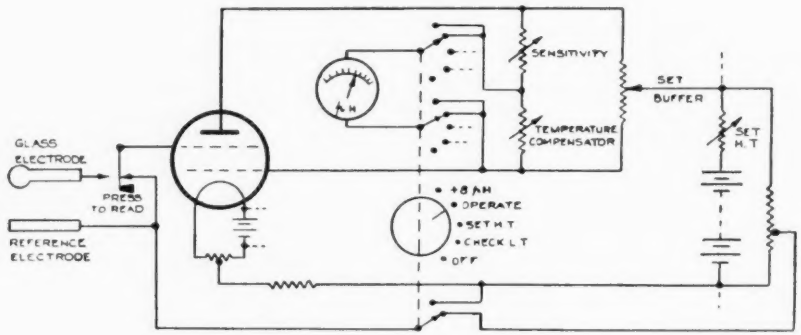
Controls are provided for adjusting temperature compensation, periodically checking scale accuracy and resetting battery conditions, but only one control is used during the actual measuring process. To make a measurement the electrodes are immersed in a buffer solution and the meter needle adjusted to the appropriate value with the "Set Buffer" control. The test solution is then introduced in place of the buffer and a reading obtained on the meter.

A press-to-read switch is located in the middle of the electrometer unit which, when pressed, connects the electrodes to the electrometer, and when released disconnects the electrodes between measurements so that random scale readings are eliminated. When a continuous indication is required—i.e. for determining a titration end point—the switch can be locked down by a press-and-twist motion.

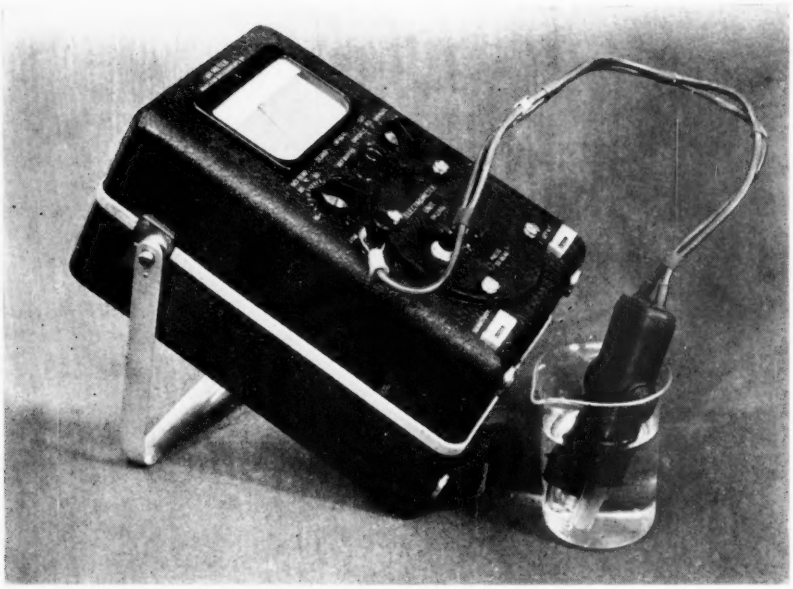
Specification

Range: 1-11 *p*H Units, with a discrimination of ± 0·05 *p*H Units.

Electrode system: glass/calomel,



Electrical connections of a Marconi *p*H meter (TF 889)



The Marconi portable *p*H meter TF 887

with a potassium chloride salt bridge.

Temperature compensation: manual 10°-50° C.

Power supply: H.T.—22½ v. L.T.—3 v. internal dry batteries. (A mains unit can be supplied for use with alternating current mains, 40-60 c/s., 200-250 v.)

Dimensions: approximately 10½ in. high by 7½ in. wide by 7 in. deep (over projections with handle down).

Weight: 8 lb. approximately.

Finish: black rivelled enamel.

Other Marconi *p*H measuring units are available for laboratory and industrial use where greater precision or a continuous record, is required.

Acknowledgment is made to Marconi Instruments Ltd., St. Albans, Herts, for the information provided in this article.

REFRACTORY WARE

WE have received from The Thermal Syndicate Ltd., Wallsend, Northumberland, a booklet entitled, "Thermal Refractory Ware." In it is outlined the products in this field manufactured by the company, including "Mullite" tubes, insulators, crucibles, thermal alumina, fused alumina, and laboratory ware in general. Information is given upon fused alumina powders and cements, which are supplied in lump or powder form to customer's requirements. Fused alumina is fabricated into furnace tubes, covering for heating elements, linings for steel combustion boats and apparatus for differential thermal analysis, muffles, trays and laboratory ware.

Recrystallised alumina ware in the form of crucibles and laboratory ware is described, as well as thermal magnesia powders and cements, tubes, discs, etc. In conclusion, products manufactured from thermal spinel, zircom, zirconia and thoria are described.

MAGNETIC SORTING BRIDGE

A BOOKLET under the above title has been issued by the General Electric Co. Ltd., Magnetic House, London, W.C.2, which describes an apparatus developed in conjunction with the Ford Motor Co.

Basically it consists of a simple electrical network in which magnetic and, indirectly, the dimensional or metallurgical properties of two samples can be compared. Those which are similar cancel themselves out whilst the differences are displayed on a cathode ray tube. The booklet describes the mathematical basis upon which the apparatus is designed so that it gives an indication as to potential uses.

HIGH DIELECTRIC CERAMICS

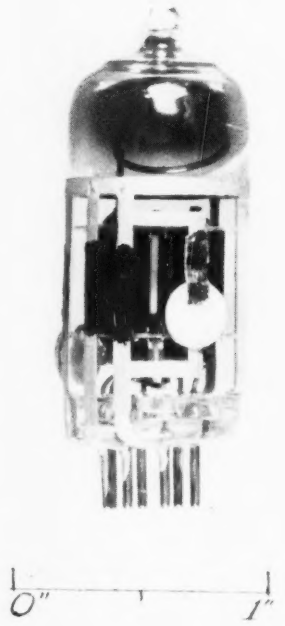
EXCLUSIVELY CONTRIBUTED

NEW ceramic dielectrics, having exceptionally high dielectric constants, have recently evolved from extensive research by George R. Shelton and Elmer N. Bunting at the U.S. National Bureau of Standards. Such dielectrics are of major importance in the production of capacitors for use in radio, radar, television, and in other special equipment where space is at a premium—such as the radio proximity fuse and hearing aids. Their extremely high dielectric constants also make them particularly adaptable for the tiny capacitors required in sub-miniature electronic devices.

Investigations Covered

The unusual electrical properties of the naturally occurring titanium dioxide mineral, rutile, have been known for over 40 years and have been useful in radio design for about 20 years. However, the very high values of dielectric constant of some of the titanates were observed only a few years before World War II began. Because of the urgent need for such dielectrics, the U.S. Signal Corps in 1944 requested the U.S. National Bureau of Standards to develop and test ceramic dielectrics. The investigation has covered a study of the properties of dielectrics prepared by systematic variation in the composition of the alkaline earth titanates.

Because the capacity of a condenser is proportional to the value of the dielectric constant of the insulating material, a great saving of space is possible when such material has an extremely high dielectric constant. Other properties, such as the break-down voltage, electric power loss and change in capacity with variation in temperature of the dielectric, must also be taken into account.



High dielectric ceramics make possible the tiny capacitors used in this miniature double-stage amplifier. The circuit elements are printed directly on the glass envelope of the miniature twin triode, the addition of tiny capacitors completing the circuit

As non-porous bodies are required for the maximum efficiency of titanate dielectrics, careful attention must be given to the original materials and to the various steps in the preparation of such bodies. Variations in the purity and grain-size of titania, and in the alkaline earth materials, frequently prevent close duplication of the properties of the dielectrics. In the current investigations at the Bureau, commercial titania (98·7 per cent. of titanium dioxide) and reagent quality carbonates of barium, strontium, calcium and magnesium are used. All of these materials are powders of extremely small grain size. For example, in one gram of titania the particles had a total surface of about 38,000 sq. cm.

In order to obtain intimate mixtures of the original materials, weighed quantities were added to distilled water and the resulting suspensions were agitated with a high-speed stirrer. The suspensions were dried and the lumps were ground and sieved. The powdered preparations, moistened with 5 per cent. of a diluted starch suspension, were dry pressed in the form of discs 3 in. in diameter and ¼-1 in. in height, preparatory to calcination.

Calcining

Calcining the preparations eliminates most of the carbon dioxide and initiates reactions that affect the properties of the dielectrics. Heating at relatively high temperatures or for long periods gave calcines from which mature dielectrics could not be prepared readily. Accordingly the mixtures were calcined for 1 hour at such temperatures that the calcines retained the property of forming compact masses when pulverised and subjected to pressure.

In the formation of specimens for study, the finely ground calcines (through a No. 325 sieve) were moistened with a starch suspension and then pressed at a pressure of 20,000 lb. per sq. in. in hardened steel moulds. The dimensions of the specimens, or discs, were 0·025 to 0·10 in. in thickness and 0·25 to 1·5 in. in diameter. In the final heat treatment of the discs, the temperatures, ranging from 100°-150° C. above those for calcination, were maintained for 1 hour. The dielectrics were considered mature when the heat treated discs had an equivalent water absorption not greater than 0·05 per cent. The maturing temperature varied from 1,250°-1,430° in the preparation of barium-strontium dielectrics.

Remaining Problems

Several problems remaining to be solved are under study at the Bureau. One is a satisfactory method for preparation of thin disc dielectrics—not greater than 0·001 in.—required for some types of capacitors. Another involves the stabilisation of the highest dielectric constants over a wide temperature range for specimens prepared from mixtures of barium and strontium titanates with constants of 10,000 to 18,000. Compared with specimens of barium-strontium titanates, thoses made from barium-calcium titanates had lower values of the dielectric constant, while the lowest values were found in the barium-magnesium titanates.

The investigations at the Bureau have shown, that, in general, the power factor of the specimens increases with increase in content of barium titanates. For example, the power factor for strontium titanate (measured at one megacycle per sec., at 25° C., and with less than 40 per cent. relative humidity) is 0·0001 while barium titanate, under the same conditions gives a power factor of 0·01. Measurements made at a frequency of 3,000 megacycles per sec. indicate a general lowering of the dielectric constant and a poorer figure of merit as compared to the values obtained at one megacycle.

Single Pot Glass Melting Furnace

At the Festival of Britain

THE single pot glass melting furnace designed and built by Sismey and Linforth Ltd., on the "Glass" stand at the Festival of Britain is a model, approximately to one-third scale of the town gas-fired furnaces built for, and worked successfully by Stuart and Sons Ltd., and Translucent Glass Ltd., the former company making high quality soda-lime glass for tableware, the latter similar glasses for illuminating ware. Another furnace is under construction for Colmore Adhesives Ltd., where sun glass lenses are made.

The raw materials, principally sand almost free from iron, potash and red lead, are charged into the fireclay pot placed within the working chamber and melt to form high quality lead crystal glass which is then gathered from the pot, blown and manipulated into shape by the glassmaker. While he is at work the furnace is automatically maintained at an approximate temperature between 1,100° C. and 1,150° C. according to the type of glassware being made. After he has worked out almost all the glass within the pot, fresh raw materials are charged and the rate of gas and air flow to the burner increased so that melting proceeds while the temperature increases to 1,350° C.

This sequence of operations, working out the glass by day and melting fresh raw materials by night involving relatively large temperature

The Sismey & Linforth Ltd. single pot glass furnace is seen in the background of this photograph, which was taken during a demonstration at the South Bank Exhibition

Chosen for

THE FESTIVAL of BRITAIN

The WEBCOT Lehr was specially designed and built to operate in a very confined space on the Glassmaking Stand in the Power and Production Pavilion, at the South Bank Exhibition.

This electric lehr has an automatic control and time switch operating mercury relays and is used for annealing tableware up to 8" high. The annealing cycle through the 10 ft. tunnel can be varied from 1 to 9 hours by an electric vari-speed having a remote control and reduction gear (45,000-1) housed in the small drive roller.

★ *Perhaps Webcot can solve your problem too !*

WEBCOT LIMITED, 14 KING STREET, NEWCASTLE, STAFFS.

fluctuations can only be carried out economically when the thermal capacity of the working chamber is not too large and yet the insulation of the chamber prevents undue loss of heat. Further, it is essential to recover a very high proportion of the heat in the waste gases leaving the working chamber by means of a tubular recuperator which imparts the recovered heat to the air for combustion. Other devices which lead to the best utilisation of the fuel are the proportioning valve of the square port type, fed with gas at a governed pressure and air from a special fan and the automatic temperature controller.

Those who have contributed to the success of this and the commercial furnaces by supplying the highest quality materials in accordance with the best principles of design laid down by Sismey and Linforth Ltd. include: The Burn Fireclay Co. Ltd., "Hyalaxe" sillimanite bricks; Moler Products Ltd., insulation bricks; Mobberley and Perry Ltd., recuperator tubes and bricks; Selas Gas and Engineering Ltd., air-gas proportioning valve; Jeavons Engineering Co., gas pressure governor and automatic safety valve; Keith Blackman Ltd., air blowing fan; Electroflo Meters Co. Ltd., automatic temperature controller; W. H. Blake and Co. Ltd., furnace steelwork; Parkinson and Spencer Ltd., siege blocks.

Hard Coke and Foundry Coke Prices.—As a result of increases in costs of production, the price of hard coke and foundry coke (except London-made hard coke) will, as from the 17th September, 1951, be increased by 1s. 8d. per ton.

Domestic and Industrial Fuel Lectures.—A series of lectures on Domestic and Industrial Fuel will be held at the Sir John Cass College, Jewry Street, Aldgate, E.C.3, on Tuesdays and Thursdays during the coming months. These lectures are being given by experts in various subjects and full details may be obtained from Dr. A. M. Ward, Principal of the College.

REFRACTORY CONCRETE

by

A. E. WILLIAMS, F.C.S.

IN recent years the development of refractory concrete for the construction and repair of furnaces, ovens, flues, and other structures subject to great heat, has made considerable progress. For many purposes it shows marked superiority over other types of refractory materials. The special characteristics of refractory concrete have led to its use on gas plants for a variety of purposes, including coke quenching floors, retort setting and patching, charge-hole blocks and the construction of horizontal and vertical flues. It is also very serviceable for constructing furnace doors, dampers and repairs to generator linings. The employment of refractory concrete for coke oven doors has proved itself in service. It is additionally used for quoin blocks at the end of the oven, and for roofing and charge holes. Experience shows that at the oven ends, it stands up to weather conditions better than ordinary coke-oven quality firebrick. It has also been satisfactorily utilised for the lining of rising mains and precast dampers.

Floor Construction

Wherever a floor is likely to come into contact with hot coke, or other hot material, a floor made with refractory concrete is capable of standing up to this excessive heat shock, and at the same time withstanding ordinary wear and tear. Floors remain in good condition under such severe circumstances that would bring about the destruction of ordinary concrete.

The use of refractory concrete in flues provides a simpler method of construction than that usually followed with bricks. For the sides of the flue can be built in concrete, using concrete slabs as covers; and where access to the flue is required, these slabs may be removed for inspection and maintenance.

Refractory concrete possesses a high degree of refractoriness and a low conductivity, while it is ready for use, being of great strength and hardness, 24 hours after placing in position. It may be used for constructing large monolithic units and it may be cast into any desired shape. Under load it is stable at temperatures up to 1,300° C. and by incorporating special types of aggregate it withstands temperatures up to 1,600° C.

Prominent Features

No pre-firing, as with ordinary clay-bonded refractories, is needed, while it has no appreciable shrinkage on drying or after-contraction and is approximately the same size at working temperatures as when originally moulded. It may be subjected to the widest sudden fluctuations of temperature without spalling, and because its thermal conductivity is less than that of the firebrick employed for its production, it possesses certain insulating value. It provides an ideal bond for setting firebricks when temperature conditions are insufficient to vitrify ordinary fireclay.

Known Properties

This type of concrete is a mixture of coarse aggregate, fine aggregate, aluminous cement and water. It differs, however, from ordinary constructional concrete, in that the aggregates consist of materials with known refractory properties, such as crushed firebrick, for example. The development of this material in which the aluminous cement known as Ciment Fondu is employed, is due to the Lafarge Aluminous Cement Co. Ltd. The idea of employing concrete as a refractory material is not new and it is natural that, originally, thoughts turned to the use of Portland cement. This material, however, is never successful as a refractory, due to its high lime content and the character of the

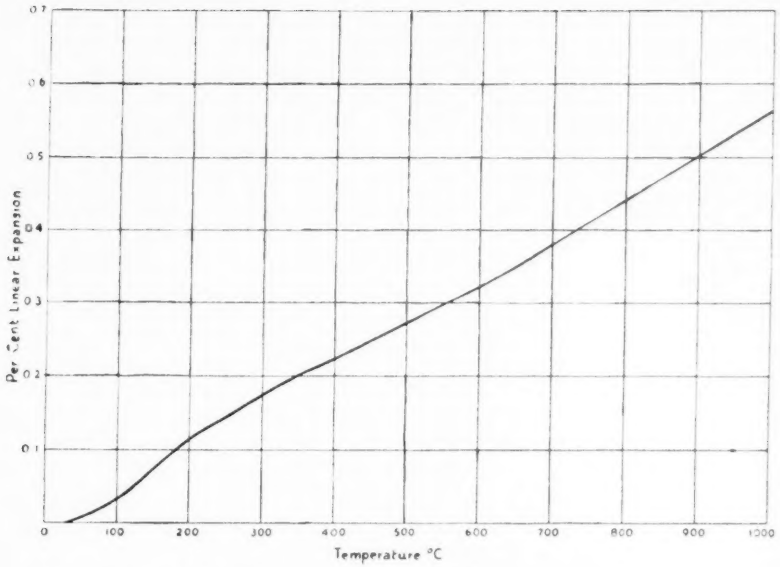


Fig. 1. Thermal expansion: 3 : 2 : 1 mixture, crushed firebrick, firebrick grog, and Ciment Fondu. Fired to 1,300° C. for 2 hours

lime compounds. In Portland cement as much as 64 per cent. of lime, CaO, may be present, and when subjected to heat, this lime forms low-melting compounds. Furthermore, after such concrete has hardened and it is subjected to furnace temperatures, it liberates lime which is subject to the effects of moisture-laden atmospheres, thus leading to a secondary breakdown. In practice it is found that the decomposition of hydrated lime in Portland cement may commence at temperatures as low as 200° C., but between 400° and 600° C. this dehydration is complete, and further heating rapidly disintegrates the cement.

On the contrary, aluminous cement contains much less lime, an average figure being 38 per cent., and what is of more importance, this type of cement does not liberate lime at elevated temperatures. For lime and alumina are combined together in aluminous cement in varying proportions to form calcium aluminates. These compounds and the eutectics resulting therefrom, have comparatively high melting points, ranging from 1,395°-1,700° C. When aluminous cement is mixed with water, the aluminates are hydrated, creating a hydraulic bond which results in a very high early strength. If exposed to the action of heat, the hydrates lose water and this dehydration is complete at a temperature of 1,000° C. At this stage, when the aluminous cement is incorporated with refractory materials, a ceramic bond develops which, when the temperature is increased still further, ultimately produces the higher melting compounds containing a larger proportion of alumina. This is an important feature of refractory concrete, because not only does this ceramic bond develop with increasing temperatures, but it also improves with continued heating. Whereas with Portland cement, if used in this manner, a high degree of refractoriness is at first apparent, but this rapidly deteriorates as a result of exposure to higher temperatures or prolonged heating, with consequent thermal breakdown.

Preparation

As aggregate, supplies of used refractory blocks, or broken unused

firebrick, may be employed; in many cases used firebrick may be employed where this can be obtained free from jointing materials, or other injurious matter. Silica bricks are not suitable as aggregate. The refractory aggregates are prepared by crushing either in a mechanical crusher or by hand, the material then been screened to the following sizes. Passing through ½ in., retained on ¼ in.; or passing through ⅜ in., retained on ¼ in. Through ½ in. graded down to fines with about 10 per cent. dust passing through the 100 mesh sieve (grog).

The proportions of crushed coarse firebrick and grog, together with aluminous cement, depend on the dimensions of the work or unit it is intended to construct. Where the dimensions and shape are of such a size that the concrete can be readily placed, the appropriate proportions are: firebrick through ½ in. on ¼ in., 3 c. ft.; firebrick through ½ in. down, 2 c. ft.; aluminous cement 1 c. ft. In other cases where the concrete cannot be so readily placed and the pattern or shape is more complex, it is preferable to utilise the ⅜ in. aggregate in the proportions of: firebrick through ⅜ in. on ¼ in., 2 c. ft.; firebrick through ½ in. down, 2 c. ft.; aluminous cement 1 c. ft. Another mix for special cases is: firebrick through ¼ in. down, 2½ c. ft.; aluminous cement, 1 c. ft. The above three mixes are classed as A, B, and C respectively.

In soaking, it is particularly important that the crushed firebrick and grog should be thoroughly saturated with water before adding the cement. Failure to do this results in the water required for hydration of the cement being absorbed by the crushed brick or grog thus leading to incomplete hydration and subsequent weakness of the concrete on firing. Consolidation of the concrete should be thorough and this can normally be carried on satisfactorily with a shovel. Owing to the large quantity of water contained in the firebrick aggregates, the application of curing water is not always necessary, but drying of the concrete before the end of 24 hours must be prevented.

In putting the work into service,

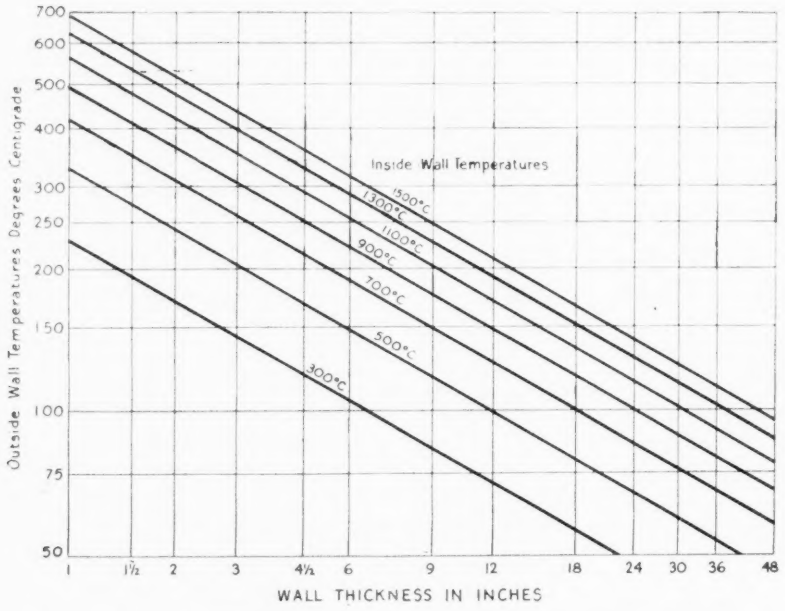
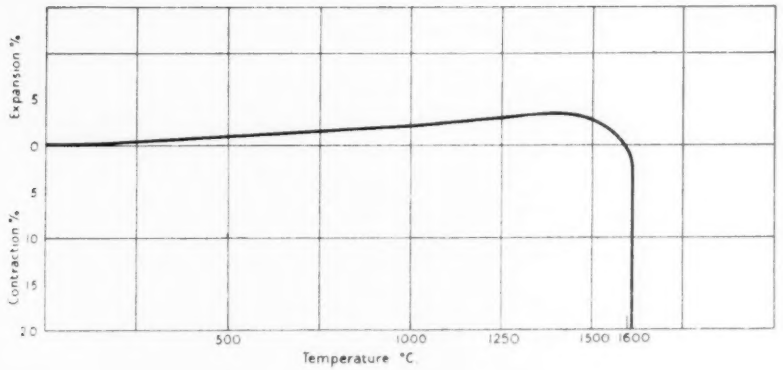


Fig. 2. Relation between inside and outside wall temperatures. Refractory concrete equivalent to 1·33 Standard Brick



Rate of Heating	10°C per min.
Initial Deformation	1420°C
Crossed Zero	1575°C
10% Collapse	1605°C

Fig. 3. Refractoriness-under-load test, 28·44 lb. per sq. in. Chrome magnesia aggregate with 10 per cent. Ciment Fondu

although slow heating over a period of 48 hours is beneficial, this is not always possible, and in spite of this difficulty, refractory concrete is capable of giving good service even when the rate of heating is rapid, and may be used 24 hours after placing. A point to be kept in mind is the fact that a considerable amount of water is incorporated in the concrete, and this water has to be expelled on the first heating.

Specific Applications

With the old type of coke oven door, the dove-tail serves to lock the concrete in position, but although such doors have been made by casting the concrete within the frame without any provision for expansion, it is sometimes preferable to line the door frame with paper to permit of some freedom of movement. Mix "A" is normally employed for this type of job. In the case of charging holes and inspection holes on coke ovens, these would normally be precast units, made in moulds designed for the purpose, with proper provision for releasing the mould when the concrete is set. Where cylindrical holes have to be made in such units, the core is best removed by a rotary movement after the initial set of the concrete, unless the hole is big enough to allow of a collapsible core which may be covered with rubber insertion to give a good surface on the concrete; this rubber insertion being wrapped around the core and after the latter is removed the rubber is stripped. The adoption of this method facilitates construction, particularly as smooth surfaces add to the life of the units.

Work in connection with door jambs of coke ovens may be either repair work or original construction. In the latter case mix "A" would be suitable, but for repairs mix "B" is normally used. The procedure may involve the erection of temporary shuttering to retain the concrete in position during the period of setting, or the concrete may be applied in limited quantities as patching. Shuttering should be removed as early as possible after the concrete is hard, and kept moist if liable to dry out due to heat emanating from other parts of the oven battery. For the construction of pipe linings, short lengths of pipes should be selected so that a wooden former may be fixed inside the pipe with sufficient clearance for placing the lining; feeding the concrete mix into the space so formed with the pipe in a vertical position. For this work mix "B" is commonly employed. In the construction of foundations, the work is

normally straightforward and the usual methods employed for placing concrete are applicable; mix "A" being used.

In the case of Wolff coke oven doors, which may be 10 in. deep with 5 in. projecting into the furnace, special care is necessary. Where the lining is made entirely of refractory concrete, current practice favours the division of this concrete by the insertion of thin metal plates, two or three to a door. To avoid lamination, the concrete is filled to the full depth at each stage; the sides of the door frame being built up with temporary shuttering to carry the projecting portion Other methods recommended are the insertion of conical bricks along the length of the door to lend support to the projecting concrete, these bricks serving as a key. In those cases where the doors have been previously constructed with part insulating brick and part firebrick, then insulating concrete and refractory concrete may be substituted. In such cases it is necessary to weld lugs to the sides of the door frame in order to lend support to the insulation and refractory concrete.

For general minor repair work, where neither mix "A" nor "B" are suitable owing to the relatively large size of the aggregate present, it is often more convenient to use mix "C" which contains no particles larger than $\frac{1}{4}$ in. This mix is useful on many occasions in addition to its employment for brick setting.

Physical Properties

In common with all refractory materials, Ciment Fondu refractory concretes and mortars expand on heating. For practical purposes the expansion of refractory concrete can be taken as identical with that of the firebrick used as aggregate. A typical expansion curve of a 3: 2: 1 refractory concrete of this type, made with crushed firebrick and grog is shown in Fig. 1. On a similar concrete testpiece fired to 1,350° C. in 4 hours and held at this temperature for 2 hours, the temperatures being measured by optical pyrometer, the after-contraction was 0·75 per cent. An interesting feature connected with the expansion of the concrete is the fact that when freshly made concrete is initially heated and during the elimination of combined water, a slight expansion takes place, followed by contraction on cooling. On reheating, the expansion is such that at a temperature of 1,000° C. the dimensions are almost identical with the original dimensions when made. This means that the dimensions of precast units when in position on reaching furnace temperatures correspond to the moulded dimensions.

The thermal conductivity of Ciment Fondu refractory firebrick concrete is lower than that for well fired firebrick, thus:

Between 355° and 40° C. 0·0023
Between 745° and 110° C. 0·0025 } Cals./cm.²/sec./°C./cm.
Between 1,140° and 190° C. 0·0026

The above figures may also be read as follows:

355°-40° C. = 6·66 B.Th.U./ft.²/hr./°F./in. or 1·50 in. Standard Brick Equivalent.

745°-110° C. = 7·25 B.Th.U./ft.²/hr./°F./in. or 1·37 in. Standard Brick Equivalent.

1,140°-190° C. = 7·55 B.Th.U./ft.²/hr./°F./in. or 1·33 in. Standard Brick Equivalent.

A comparable value for well fired firebrick between the range of 1,140° and 190° C. = 9·6 B.Th.U./ft²/hr./°F./in.

A Covenient Method

The Standard Brick Equivalent gives a convenient method of expressing refractories on a common conductivity basis. This Standard Brick Equivalent is equal to 10/K where K is the thermal conductivity in B.Th.U., etc., for any refractory or insulating material. A brick having the conductivity of 10 B.Th.U./ft²/hr./°F./in. has been selected as a standard, and the higher the resistance, or alternatively, the lower the conductivity, the higher will be the Standard Brick Equivalent. The graph, Fig. 2, shows the relation between the outside wall temperature and furnace temperatures for refractory firebrick concrete. This has been calculated on the basis of a conductivity equal to 7·55 B.Th.U./ft.²/

hr./°F./in. An additional use of this graph lies in the fact that calculations can be made of the mean wall temperature and the mean compressive strength. At the same time it is possible to estimate the temperature at the interface between one type of refractory or insulating material, and another.

This involves converting the various types of refractory, or insulating material, to Standard Brick Equivalent, and for the purpose of reading off on Fig. 2, which is prepared on a basis of refractory concrete, this S.B.E. must be divided by 1·33. One might then have, for example, a wall made up of 9 in. of firebrick, 4½ in. of refractory concrete, and 4½ in. of building brick. If the hot face temperature is taken to be 1,500° C., then the procedure would be as follows:

Firebrick:	S.B.E. is $9 \times 0{\cdot}85$	$= 7{\cdot}65$
Refractory concrete:	,, is $4{\cdot}5 \times 1{\cdot}33$	$= 6{\cdot}00$
Building brick:	,, is $4{\cdot}5 \times 1{\cdot}66$	$= 7{\cdot}55$
	(Standard Brick)	$21{\cdot}20$

$$\text{or } \frac{21{\cdot}20}{1{\cdot}33} = 16 \text{ in. of refractory concrete.}$$

The graph, Fig. 2, may now be applied. With an inside wall temperature of 1,500° C. and a wall thickness of 16 in. of refractory concrete, by reading off on the scale, the outside wall temperature will be 180° C.

Temperature at Interfaces

To determine the temperature at the interfaces between the respective materials, it will be seen that the temperature gradient is from 1,500°-180° C. through 21·2 in. of Standard Brick, that is to say 62·5° C. per in. of wall. Therefore, the drop from hot face to the interface, between firebrick and refractory concrete is $7{\cdot}65 \times 62{\cdot}5 = 477°$ C., and the temperature at interface is 1,500°-477° C. = 1,023° C. Similarly, the drop from hot face to the interface between the refractory concrete and building brick is $6{\cdot}00 + 7{\cdot}65 = 13{\cdot}65 \times 62{\cdot}5 = 855°$ C. and the temperature at interface is 1,500°-855° C. = 645° C.

Higher Refractories

By the employment of higher refractory materials in place of firebrick, such as chrome, magnesia, or fused alumina, an increase in the refractoriness can be obtained with Ciment Fondu mortars up to temperatures of 1,770° C. As with firebrick, this refractoriness is in part determined by the proportions of the materials incorporated in the mix. The increased refractoriness is brought about by a combination between the cement and the fine portions of the refractory material.

Mixtures of calcined magnesia and chrome with Ciment Fondu, either when rammed or moulded under pressure, show high cold strength, volume stability or slight expansion on firing, high resistance to softening under load, good resistance to spalling and good slag resistance. Moulding under pressure increases the start to fail temperature in the refractoriness-under-load test, but not the final collapse. Magnesite should not be incorporated in the fines, as this results in high shrinkage and low refractoriness-under-load. The most suitable mixes range between 10 and 15 per cent. of the aluminous cement. A typical refractoriness-under-load test result is shown by the graph, Fig. 3.

Refractory firebrick mixtures may be fortified by introducing a proportion of fused alumina, or other higher refractory, thereby raising the refractoriness.

Gibbons Bros. Ltd.—"Post War Report" is the title of a well-produced booklet by Gibbons Bros. Ltd., Dibdale Works, Dudley. This takes the form of pictorial survey of a selection of the principal plants built by the company since hostilities ceased in 1945. The foreword apologises for the absence of certain plant, but comments that "these can come in the next edition."

Heavy Fuel Oil Prices.—Shell-Mex and B.P. Ltd., announce an increase under their Inland Trade Price Schedule of 1½d. (three halfpence) per gallon for Shell Heavy Fuel Oil and B.P. Heavy Fuel Oil, effective from the 20th August, 1951. This advance arises from very considerable increases in world prices, freight rates and other costs, which have not hitherto been fully reflected in the prices of these products.

Research and Development in the Potteries

RECENTLY the British Pottery Manufacturers' Federation entertained members of the Staffordshire Society and in the course of speaking at a dinner held in the Federation Club, Stoke-on-Trent, the president of the Federation, Mr. George Campbell, referred to the work which had been done in the area towards progress in the ceramic industry.

He mentioned that less than fifty years ago lead poisoning and silicosis were scourges, but that now risks from these diseases were practically negligible. He also referred to the gradual evolution of the factories from rule of thumb methods to close scientific control, and pointed out how the range of technical ceramics had played a vital part in the electrical grid system, aircraft manufacture and electronics.

Lithography

Referring specifically to decoration and lithography he said this has enabled the potter to ornament his wares with beautiful colours similar to hand-painted and at a fraction of the cost. It is to be hoped that some day the prosperity of the country will improve sufficiently to permit the inhabitants of this isle and Northen Ireland once more to purchase bright patterns which may cheer them when they partake of their rather meagre rations.

From all quarters you have probably heard that we are too conservative. We would defend the accusation of conservatism in art design by pointing out that in spite of repeated efforts from external advisers, the designs currently marketed by our domestic ware industry are in greater demand than ever. Our artists must not take all the credit for this to themselves; their creations are reproduced by the finest craftsmen in the world. Our conservatism in technical developments needs no defence, on the contrary, if we had erred in the opposite direction and plunged prematurely into adopting new ideas, our goodwill in the world markets might have been jeopardised.

Any firm doing a large export business would have done incalculable harm to the prestige of British pottery if it had discarded the old-fashioned ovens in favour of the first continuous kilns which were on the market. Since continuous firing has been proved for practically every purpose the changeover has been rapid, and since the war the pace has partly been governed by factors outside our control.

Those sections of the industry most adaptable to mechanisation have already reorganised their factories and the whole of the pottery industry is now eager to explore all the labour-saving devices that engineering can bring to its aid.

Research

Mr. Campbell paid particular tribute to Dr. H. W. Webb, Principal of North Staffordshire Technical College, and to Dr. Green at the British Ceramic Research Association whilst he also referred to the enormous efforts made by Colonel Thomas on the refractory side of the industry and to Colonel Johnson on the pottery aspect. He said that in the not too distant future the new research laboratory will be formally opened, when, I am sure, Colonel Johnson will feel a sense of achievement which will be some recompense for all the work he has done, and for all the teething troubles he has nursed us through with such unflinching courage.

This industry has been controlled successfully by sound practical potters in the past and fortunately there are plenty of promising young men with the same qualifications to control it in the future, but if they are going to triumph over the keen competition which is rising against us, they must have increased assistance from scientific research. The matter is of such paramount importance that it is to be hoped that every firm will increase its

own activities in this field in addition to supporting the British Ceramic Research Association. Inventors should reap rewards from their efforts and those firms who are doing individual research work have prior claims on their discoveries.

Nevertheless during the first years of the short span I have reviewed, manufacturers were unnecessarily secretive — now we have grown broader minded and help each other along the path of progress, a policy which is in accordance with Christian ethics and consequently, I believe, in accordance with commercial wisdom.

THE FRAMAC CHAIR

SPECIALLY designed to comply with the requirements of the Factory Act, the Framac chair, by Macdonald Fraser, Mandalay Street, Basford, Nottingham, embodies such special features as a welded steel chassis frame, finished in durable green enamel; large laminated plywood sprung seat, with adjustable backrest; a standard footrail. All woodwork is french polished, and as optional fittings either steel domes or rubber feet are supplied. The chairs are revolving and adjustable for height.

The company also supply fixed height chairs and stools, and a simply fitted backrest to convert existing stools and chairs.

The Framac chair

REPRINTS

. . . from CERAMICS are available as below and will be posted freely to those interested.

"THE WALKING BEAM KILN," by L. Bailly. (International Furnace Equipment Co. Ltd.)

"NEW TUNNEL KILN FOR REFRACTORY SPECIALS." (Gibbons (Dudley) Ltd.)

"THE COLLINGHAM AND OWEN AUTOMATIC TILE PRESS." (Sheepbridge Engineering Ltd.)

"THE MANUFACTURE OF GLASS LABORATORY WARE." (Quickfit & Quartz Ltd.)

"SINTER ALUMINA AS ENGINEERING MATERIAL FOR CUTTING TOOLS AND TURBINE BLADES." Dr. Felix Singer.

"MAGNETIC FILTERS AND THE POTTERY INDUSTRY," by R. A. Etherington. (Philips Electrical Ltd.)

"SOME NOTES ON MODERN ELECTRIC INTERMITTENT KILNS." (James Royce Electric Furnaces Ltd.)

"A GLASS ANNEALING KILN INSTALLATION," by B. W. E. Webber. (Webcot Ltd.)

"SOME APPLICATIONS OF STEEL BAND CONVEYORS," by E. Bealing. (Steel Band Conveyor & Engineering Co. Ltd.)

"AN ULTRA-MODERN PIPE FACTORY." (Sharp, Jones & Co. Ltd.)

"WORK MEASUREMENT—ITS APPLICATION TO THE POTTERY INDUSTRY," by H. A. F. Rowntree.

"LOW SOLUBILITY LEAD GLAZES." (W. Podmore & Sons Ltd.)

"FUEL OIL IN THE GLASS INDUSTRY," by D. Sismey and M. Roddan. (Sismey & Linforth Ltd.)

"STAGES IN THE DEVELOPMENT OF A SEMI-AUTOMATIC MAKING MACHINE," by F. C. Cooper. (Bennis Mechanisations Ltd.)

"A CUP 'HANDLING' MACHINE." (Service (Engineers) Ltd.)

"ABRASIVE-RESISTANT ALLOY." (Follsain-Wycliffe Foundries Ltd.)

"SOME USES OF VERMICULITE," by W. B. Dodgson. (Dohm Ltd.)

"INCREASED EFFICIENCIES AND REDUCED FUEL COST," by A. Williams-Gardner.

"NEW DEVELOPMENTS IN FIRING AND DRYING PROCESSES," by L. Bailly. (International Furnace Equipment Co. Ltd.)

"MECHANISATION IN THE POTTERY INDUSTRY," by John A. Johnson. (Pottery Managers' and Officials' Association.)

"MODERN DEVELOPMENTS IN TUNNEL KILN PRACTICE," by R. G. Le Grip. (Gibbons Bros. Ltd.)

"A COMBUSTION SAFEGUARD CONTROL TO AVOID EXPLOSIONS IN CERAMIC FURNACES," by H. A. Stevenson. (Ether Ltd.)

Write CERAMICS, 157 Hagden Lane Watford, Herts.

Preferential Gas Tariff for the Potteries

AN important application was made to the West Midlands Gas Consultative Council at Birmingham recently on behalf of the pottery industry in North Staffordshire for a preferential rate, when it was stated that the industry used more than half the output of the Stoke-on-Trent gasworks. In support it was argued by Mr. R. A. Maddock, the Federation of British Industries representative on the council (who introduced a deputation from the British Pottery Manufacturers' Federation of whose gas committee he is chairman), that the industry required a continuous load favourable to gas undertakings and that competition was increasing from the Continent and elsewhere, which meant that costs must be reduced.

The deputation consisted of Mr. Maddock (John Maddock and Son, Burslem), Mr. James Meakin (J. and G. Meakin, Hanley), Mr. John Plant (R. H. and S. L. Plant Ltd., Longton), Mr. Ralph Halkett (Gas Consultant to the British P.M.F.) and Mr. S. H. Jerrett (deputy-chairman of British P.M.F.). Mr. Maddock first of all mentioned that it was largely due to the wisdom and foresight of Mr. Hewitt (a member of the Gas Board), Alderman Williams and Councillor H. Hewitt (members of that consultative council) that the gas undertaking at Stoke-on-Trent had reached the position it occupied today. It is probably appreciated that it was one of the most efficient undertakings in the West Midlands, and those and other representatives in the district had the foresight to realise the possibilities of gas consumption in the pottery industry and made provision for it. They not only sold gas at a low rate but made a profit; and, of course, they would also appreciate that the potteries is very close to an important coalfield.

Competition from Abroad

The pottery industry, Mr. Maddock proceeded to say, was now faced with competition from abroad. On the Continent and in North America manufacturers were starting to meet bulk requirements and producing a very good article. They now had to compete with a serious amount of Japanese production, and the Germans are also cutting into the markets which had hitherto been supplied by British pottery makers, so that they are really up against it in North Staffordshire. Our main point is as regards gas usage that we can give you a basic load for seven days a week and fifty-two weeks a year, which no other manufacturers can do, said Mr. Maddock. We do not stop on Friday night and start up again on the Monday; we are consuming gas all the time, and no other industry can offer you a base load equivalent to ours. In view of this fact, we ask whether you will put our case to the Gas Board for a preferential rate, for the price of gas at the moment is frightening already. A few pottery firms are firing with oil, and it would be a very serious thing for the North Staffordshire gas undertaking if pottery manufacturers turned to oil. However, he believed Mr. Jerrett had sent the chairman a statement which went more fully into the matter, and if there are any questions which members would like to ask the deputation he would be glad to answer them.

Communication from Manufacturers' Federation

The chairman (Councillor W. H. Malcolm, J.P.) then read the communication from the British Pottery Manufacturers' Federation, inviting the Gas Consultative Council to give consideration to the following facts concerning directly or indirectly, the current prices charged for gas to the industry, with the object of negotiating with the industry for a more favourable rate for those industrial consumers using 19,000 therms per quarter, and above, on a continuous loading, and taking their supplies from Stoke-on-Trent district.

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in both biscuit and glost stages is *the* essential factor in production. These two processes together account for 40 per cent. of the total production costs of whiteware. The proportion of production cost attributable to fuels average 5 per cent. in these operations.

2. Continuous firing methods have been increasingly adopted during the last 20 years.

3. These methods were encouraged by the Stoke City Undertaking who were able, by virtue of the extremely high base load factor necessitated by continuous kilns and the local abundance of long flame gas coal, to produce gas efficiently and to sell it at a low price. It was because of the availability of supplies of coal that the pottery industry developed in North Staffordshire, and not for reasons of raw materials.

4. The base load of the industry is a constant 24 hours per day 352 days of the year. No other industry can claim so constant a base load.

5. 173 gas-fired kilns have been installed since 1932, and are supplied by Stoke-on-Trent undertaking. Of these, eighty-six have been put into operation since 1946.

6. The consumption of these kilns in 1950 was 4,111,000,000 c. ft. against a total output of Stoke-on-Trent Etruria gas works recorded as above 7,225,000,000 c. ft. This represents a proportion of 57 per cent. It is most important to appreciate that this proportion of consumption is a constant load.

7. Under the present tariff all consumers obtain a *pro rata* "preferential" rate dependent upon their quarterly thermal consumption, but irrespective of their base load factor.

8. It is submitted that the continuous demand of the modern method of pottery firing, together with the quantities consumed justify a preferential rate lower than that offered by Scales 8 to 14 in the Stoke-on-Trent gas tariffs.

9. The pottery industry is one of the leading export industries of the country, which has recently been encouraged by the Board of Trade to increase its sales in export markets. Such sales depend on manufacturers

being able to place their goods on export markets at competitive prices. To do this, is becoming more difficult owing to foreign competition from U.S.A., Canada, Japan and Germany and other pottery producing countries. Constant increases in production costs must reflect to the detriment of these prices ultimately. Those manufacturers who are most actively concerned in our export drive are almost uniformly consuming over 47,500 therms per quarter on Scale 13 (or over). The price of gas has increased 51 per cent. since 1949; this represents an increase in factory costs of 2½ per cent., due to the price of gas alone. This is equivalent to 6d. in every £1 costs.

In 1950 the pottery industry exported £20,000,000 of pottery and to maintain, or even increase, this figure in the face of hardening markets requires every economy.

10. In view of the consumption of the industry in the Stoke area being 57 per cent. of the production, the B.P.M.F. asks what the affect on the price of gas within that area would be if the manufacturers decided to switch to one of the alternative fuels, viz.: electricity or heavy fuel oil. Such alternatives, whilst not so efficient are rapidly becoming more economical. As an example, the price of heavy fuel oil is equivalent to 5·36d. per therm, compared with an average of 7·5d. per therm (at current rates) for gas.

No Precedent

The statement concluded: "we would suggest for your consideration in the light of the facts given above, that those members of our industry who are providing you with a steady base load at a rate of 19,000 therms and above per quarter, should receive their gas at a rate of 1d. per therm less than that rate being charged to other industrial consumers in the Stoke area. We would mention that our request is, in our opinion, most reasonable and one that is practised by other area boards; and, indeed, was the practice of several gas undertakings prior to nationalisation where large industries were concerned. It is, therefore, submitted that no precedent would be created by your Board in granting our request."

The chairman said he had only received this document that morning, and it needed close consideration before any recommendation could be made. Mr. H. Baker (Birmingham) said other area boards were stated to give a financial concession to certain industries, and asked was this so. Mr. Maddock, appealed to, said this occurred with East Midlands, North-Western and Northern areas, all on base loads. Mr. Baker next asked what were the other industries given a preferential rate or treatment. Mr. Jerrett replied ship-building in the north; in the north-west some light industries and large scale bakeries; and in the East Midlands steel and wire rope industries; to cite some examples. This was on account of a base load, and he thought the pottery industry had the most valuable base load of all; they even required it on Bank Holidays. He did not think it mattered what industry it was so long as the quantity of gas supplied was adequate to form a base load.

Gas—No Guarantee

In reply to Mr. J. Fallon (Incandescent Heat Co., Smethwick) as to the 173 gas-fired kilns in use, Mr. Jerrett said there are in addition many more on oil and electricity. Mr. Maddock pointed out that electricity was more expensive than gas, but as there was some escape of heat in using the latter fuel there was in comparison a saving of current which was very appreciable. The position was that if they wanted to install kilns for electric treatment the Electricity Board would supply current for the plant, but the Gas Board would not now guarantee gas fuel. Alderman Williams elicited that in addition to the 173 gas-fired kilns there were pottery manufacturers who had their own gas producer plant. On this point a lady member said it seemed that more importance was attached to rearmament than to exports.

Before Nationalisation

Mr. Baker asked could they have details of preferential treatment manufacturers received before nationalisation. Mr. Maddock replied that in the potteries they took their hats off to the people who had previously been running their gas undertaking

for supplying gas at a special rate; and he would also like to take his hat off to the West Midlands Gas Board because according to reports received they were also running this undertaking very efficiently. So far as he could see, what was happening was that their efficient Etruria undertaking now had to help support the less efficient or smaller undertakings around, but they could not help that. But part of their argument was that as they relied on and lived by gas fuel to a great extent, they should have a preferential rate of treatment.

Mr. Baker asked did they actually receive preferential treatment from the local authority and if so would it be stated what it amounted to as compared to, say, the baker next door. Mr. Maddock said he would have to refer to the records for specific figures. However, Mr. Halkett replied that in May of 1949 the pottery manufacturers were paying 4·8289d. per therm for gas, which was 54 per cent. of the domestic price. In August of 1951, up to the last increase they were paying on Scale 14 7·3289d., an increase of 51·8 per cent. and it went up to 54·5 per cent. of the domestic price.

Only Large Consumer

Replying to another question, what was the comparison with other manufacturers as regards the rate, or did other manufacturers have to pay more, Mr. Maddock said the answer was that the pottery makers were the only large consumers in the districts supplied by Stoke-on-Trent gas undertaking. They consumed 57 per cent. of the output, and the total industrial consumption was 66 per cent. for all industries. For the rest of the industry the scale was exactly the same.

Mr. Fallon remarked that pottery exports are fairly high. "In the china and earthenware industry," said Mr. Maddock, "70 per cent. went to Canada and the U.S.A.," which is very important, commented Mr. Fallon.

Mr. F. H. Cureton (secretary of the West Midlands Gas Board, deputising for the chairman of the Board) asked was there a request by the deputation for a price in respect of a consumption in excess of 19,000 c. ft. per quarter, or was it suggested that the concession should apply to the whole quantity. If it was the latter then consumers having large consumption which was less than 19,000 c. ft. would obviously have a grievance.

In reply Mr. Halkett stated that they wished the concession to apply to the whole quantity, and suggested to meet the difficulty referred to that there be "a marginal clause" introduced in applying the concession. Mr. Cureton pointed out that conditions were now different compared with pre-nationalisation years. The Board were under a statutory obligation under the Gas Act not to show undue preference to any consumer or class of consumer, and here there was a problem.

Referred to Gas Board

The chairman then thanked the deputation for coming along, and after they had left it was proposed and seconded that without further discussion the memorandum be sent to the West Midlands Gas Board asking them "to give it their careful consideration in computing their tariffs." We ourselves cannot very well go into it in anything like the detail required, added the chairman.

Before the resolution was put and carried unanimously, Alderman W. Evanson (deputy mayor of Newcastle-under-Lyme) asked was it understood that the matter had already been before the Board. The chairman said: "No; the Board declined to see the deputation, and referred the matter to us. It is entirely up to the Board now to consider whether they should treat the pottery manufacturers comparably with other industries."

"RAILS"

UNDER this heading, Thomas W. Ward Ltd., Albion Works, Sheffield, set out to assist those interested in private railway sidings, when they are ordering rails and track accessories. In the booklet they describe, with full dimensions, bull head rails, flat bottom rails, railway chairs of different varieties, spikes, screws, fish plates and standard fastenings.

Dimensional and sketch information on lever boxes, communicating rods, buffer stops, wheel stops, as well as switches and crossings complete the information.

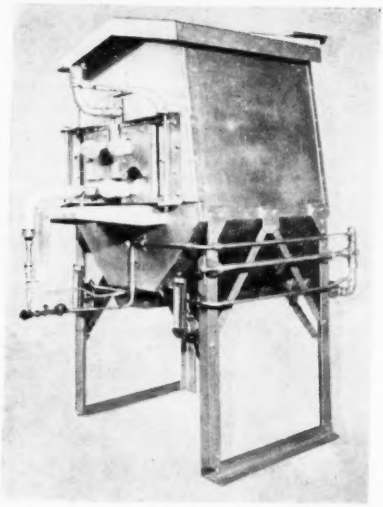

Fig. 1. The South Eastern Gas Board Ceramic Kiln No. 1797

CERAMIC KILN No. 1797

A MUFFLE kiln (Fig. 1) made by South Eastern Gas Board, which can be lined for a temperature of 1,100° C. or alternatively of 1,300°-1,350° C. of intermediate size with internal dimensions 14 in. wide by 13¾ in. high by 18 in. deep, is suitable for both amateur and professional art potters.

Features of the kiln are evenness of heating, extreme flexibility of temperature control due to the single neat, i.e., post aerated gas flame burner and the water gauge gas pressure indicator, termination of primary flue at kiln height and suitability of height of muffle hearth for working.

The temperature is attainable by natural draught, i.e. without the use of fans or compressors, and the kiln is quiet in operation.

In firing glazes requiring reducing or oxidising atmospheres, special

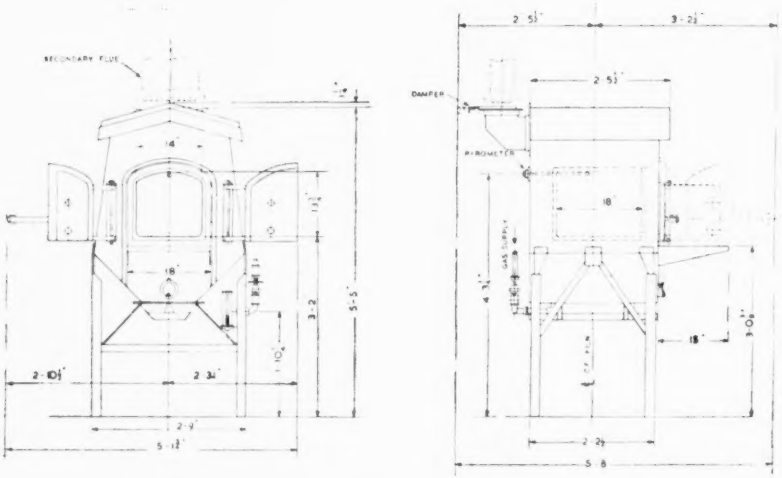

Fig. 2. Diagrams showing construction details of the kiln

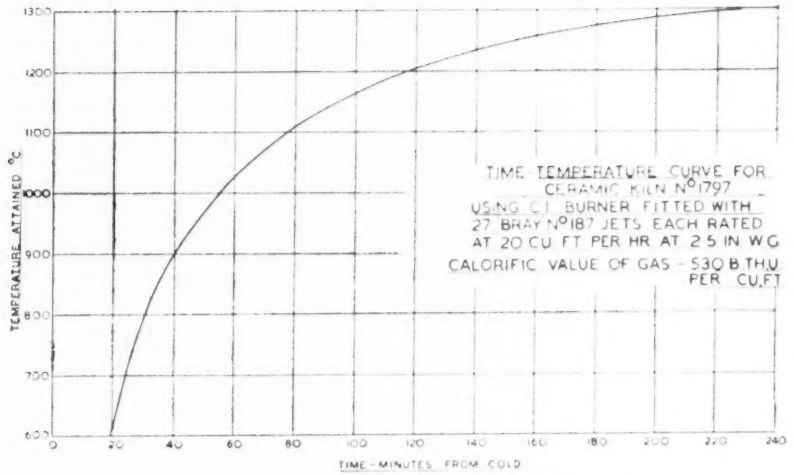

Fig. 3. Time/temperature curve for Ceramic Kiln No. 1797

"purging" arrangements can be provided.

Construction

The casing of the kiln is shaped as shown in Fig. 2, and is constructed of self-colour M.S. sheet. The top cover plate is removable to allow access into the interior lining.

Four rigid legs of rolled steel angle, suitably strengthened by horizontal cross-members of rolled steel angle and M.S. flat bracing, support the casing. A shelf, measuring 1 ft. 6 in. long by 1 ft. 3 in. wide is attached to the front of the casing by a small rolled steel angle bearer.

The casing is lined with insulating firebrick material, a slot at the base of the lining being left into which the refractory burner tips project.

The muffle is of silicon carbide, having a $\frac{1}{2}$ in. diameter hole provided in the back coinciding with a hole of the same diameter through the refractory lining and casing and permitting the introduction of a thermocouple, the temperature indicator being fixed in some convenient position near the kiln.

The kiln is fitted with side-hinged twin refractory lined doors, opening to the left and right, in which four holes tapered from 2-1$\frac{1}{2}$ in. diameter by 4$\frac{1}{2}$ in. deep, each closed by a refractory plug, are provided for sighting purposes.

The flue outlet, which is situated toward the rear of the top of the kiln has a lining of insulated firebrick and is provided with a mild steel adjustable damper.

A lighting port with a C.I. bottom-hinged cover is provided at the lower front of the kiln, for lighting and viewing the burner.

One single tube gas pressure water gauge is located at the lower right front of the kiln connected to a point between the main control cock and the burner to indicate the gas pressure at the burner for any setting of the cock.

Another similar gauge is located at the lower left front of the kiln, connected to a point between the pressure governor and the main control cock to indicate the gas pressure for any setting of the "purge" gas control cock.

Overall dimensions are, height 5 ft. 6$\frac{1}{4}$ in., height (floor to hearth) 3 ft. 2 in., width 3 ft. 1 in., depth (including damper and shelf) (for

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other information see Fig. 2) 4 ft. 7½ in., with an approximate working space of 2 c. ft.

Burner Equipment

The kiln is provided with a post-aerated C.I. burner carrying twenty-seven Bray No. 187 refractory burner tips cemented in position. The burner is supported by M.S. brackets bolted to the underside front and rear of the casing.

Beneath the burner is a M.S. radiation protection tray supported from the casing by bolts having wing nuts to facilitate removal.

A lighting torch, connected between the gas pressure governor and the control cock should be provided when installation is made.

The main gas connection is made to the ¾ in. B.S.P. tee provided at rear R.H. side of the kiln, whilst a primary flue outlet with internal dimensions 11 in. long by 4 in. wide is provided, terminating at the top rear of the kiln, and fitted with a rectangular M.S. adjustable damper plate.

Gas Control Equipment

Gas control equipment consists of a ¾ in. B.S.P. washer-nited cock with square headed plug having an extended "T" head turn-key permitting operation from the front of the kiln, and two 6 in. single tube, liquid gauges for registering gas pressure.

The approximate weight of the kiln is 7 cwt.

Installation Notes

A secondary flue, including draught diverter or baffler, is recommended, according to local conditions. It is necessary to fit a 1¼ in. gas pressure governor on the meter side of the ¾ in. connection tee.

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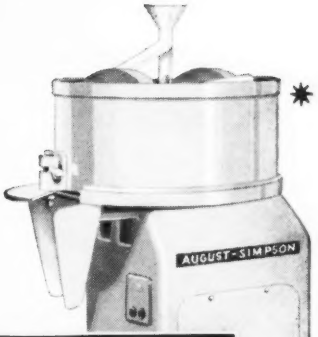

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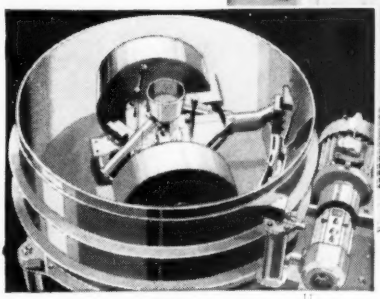

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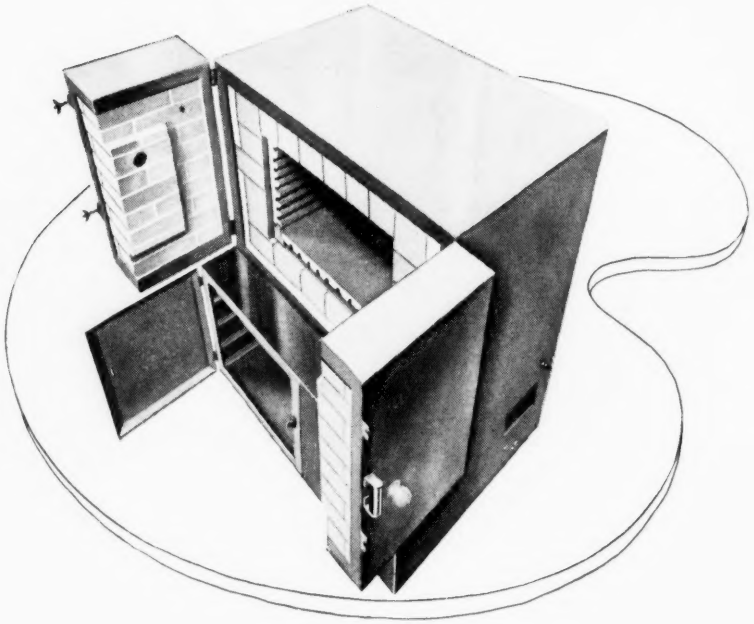

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